Engineering Calculations and Analysis

ECAR Title: AGR-1 Daily As-run Thermal Analyses

ECAR No.: 968

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1. Confirmation of completeness, mathematical accuracy, and correctness of data and appropriateness of assumptions.
2. Concurrence of method or approach. See definition, LWP-10106.
3. Concurrence of procedure compliance. Concurrence with method/approach and conclusion.
4. Concurrence with the document's assumptions and input information. See definition of Acceptance, LWP-10200.

REVISION LOG

Rev.	Date	Affected Pages	Revision Description
1	10/24/2011	All	This revision shows the thermal calculations of the AGR-1 daily as run analysis, which includes the following changes: • Control gas gaps and compact-graphite holder gas gaps changing linearly with time. The final gas gaps were obtained from post-irradiation measurements. • Individual component heat rates used for graphite. • New heat rates used from Revision 1 of physics analysis. • Comparisons between normalized fuel temperatures and normalized log (R/B) of radionuclide Kr-85m.
2	01/25/2012	60 and 61	This revision corrects the time average minimum temperatures at end of irradiation in Tables 3 and 4.

1. Quality Level (QL) No.	QL 2	**Professional Engineer's Stamp**
2. QL Determination No.	REC-000169	
3. Engineering Job (EJ) No.	X	
4. eCR No.	X	
5. SSC ID	AGR-1	
6. Building	TRA-670	
7. Site Area	533	

8. Objective/Purpose:

The purpose of this report is to document results of the thermal analyses performed to calculate the AGR-1 as-run daily temperatures of the fuel compacts. Time average volume average data provided by this report will be used to determine fuel performance in the post-irradiation examination.

9. Conclusions/Recommendations:

This report documents the results of thermal analyses to predict the daily as-run temperatures for the AGR-1 experiment. Daily heat rates for each component in the models were input from daily as-run physics analyses. Daily gas compositions and component fluences were also input. Six different finite element models were created for the six different AGR-1 capsules. Each capsule had a different gas gap that was implemented to control the temperature of the experiment. Capsules on the top and bottom had larger gas gaps, while capsules in the middle were smaller.

Gas mixture thermal conductivity was implemented using the kinetic theory of gases. Fluence dependent thermal conductivity was used for the graphite components and the fuel compacts. Radiation heat transfer was implemented with emissivity of all surfaces being 1.0 in order to match as closely as possible the experimental thermocouple (TC) temperatures.

In general most predicted temperatures were hotter than the measured TC temperatures by about 50°C. Many of the TCs failed during the experiment. Heat rates, and hence temperatures, were very sensitive to the outer shim control cylinders as shown at the end of the 3rd cycle (139B). Time average volume average temperature values were calculated in order to be used in the post-irradiation examination, knowing which capsules were the hottest or coolest on average.

CONTENTS

SCOPE AND BRIEF DESCRIPTION

This report documents the daily as-run thermal analyses performed on Advanced Gas-cooled Reactor (AGR) experiment AGR-1 in the Advanced Test Reactor (ATR). Several fuel and material irradiation experiments, which support the development of the Next Generation Nuclear Plant (NGNP), are planned for the Advanced Gas Reactor Fuel Development and Qualification Program. The goals of these experiments are to provide irradiation performance data to support fuel process development, to qualify fuel for normal operating conditions, to support development and validation of fuel performance and fission product transport models and codes, and to provide irradiated fuel and materials for post-irradiation examination (PIE) and safety testing. AGR-1 was the first in this series of planned experiments to test tristructural-isotropic (TRISO)-coated, low enriched uranium oxycarbide (LEUCO) fuel. The AGR-1 experiment was intended to serve as a shakedown test of the multiple capsule test train designs to be used in subsequent irradiations and to test early variants of the fuel produced under this program.

The AGR-1 experiment is comprised of six individual capsules, approximately 1.375-in. in diameter by 6-in. long, stacked on top of each other to form the test train. Each capsule contains 12 fueled compacts that are approximately 0.5-in. in diameter by 1-in. long. The compacts are composed of fuel particles bound together by a carbon matrix. Each compact contains approximately 4,150 fissile particles (35 vol% particle packing fraction). Each capsule will be supplied with a flowing helium/neon gas mixture to control the test temperature and to sweep any fission gases that are released to the fission product monitoring system. Temperature control is accomplished by adjusting the gas mixture ratio of the two gases (helium and neon) with differing thermal conductivities.

Gas gaps were taken from Ambrosek in Reference [1]. A nominal east lobe source power of 22.47 MW was used to normalize the power amplitude in the thermal analysis. The finite element heat transfer code ABAQUS[2] was used to perform the thermal analysis.

The AGR-1 experiment was placed in the B-10 position in the ATR core as shown in Figure 1. The AGR-1 experiment capsule assembly consists of six capsules axially stacked. Each capsule contains a graphite holder with three equally spaced fuel compact holder openings as shown in Figure 2. Each holder opening accommodates four axially stacked fuel compacts. Thus, each capsule has three stacks by four fuel compacts per stack for a total of 12 fuel compacts per capsule. So, within the entire AGR-1 experiment capsule assembly, there are six capsules by 12 fuel compacts per capsule for a total of 72 fuel compacts. Six finite element heat transfer models were created (one for each capsule), each with a corresponding gas gap.

For the analysis, baseline fuel compacts were placed in Capsule 6 (top capsule) and Capsule 3, Variant 1 fuel compacts were placed in Capsule 5, Variant 2 in Capsule 2, and Variant 3 in Capsules 4 and 1. Each AGR-1 fuel compact was subdivided into two equal-sized cells/nodes. Thus Stack-1 is comprised of Nodes 1–48 (eight nodes per capsule times six capsules), Stack-2 is comprised of Nodes 97–144, and Stack-3 is comprised of Nodes 49–96. Figure 3 shows the axial arrangement for Stack-1. The ABAQUS models have a direct volume-for-volume correlation with the physics model for the heating of the compacts as described above (each compact is evenly axially divided into two equal parts). An axial cut of a typical capsule is shown in Figure 4.

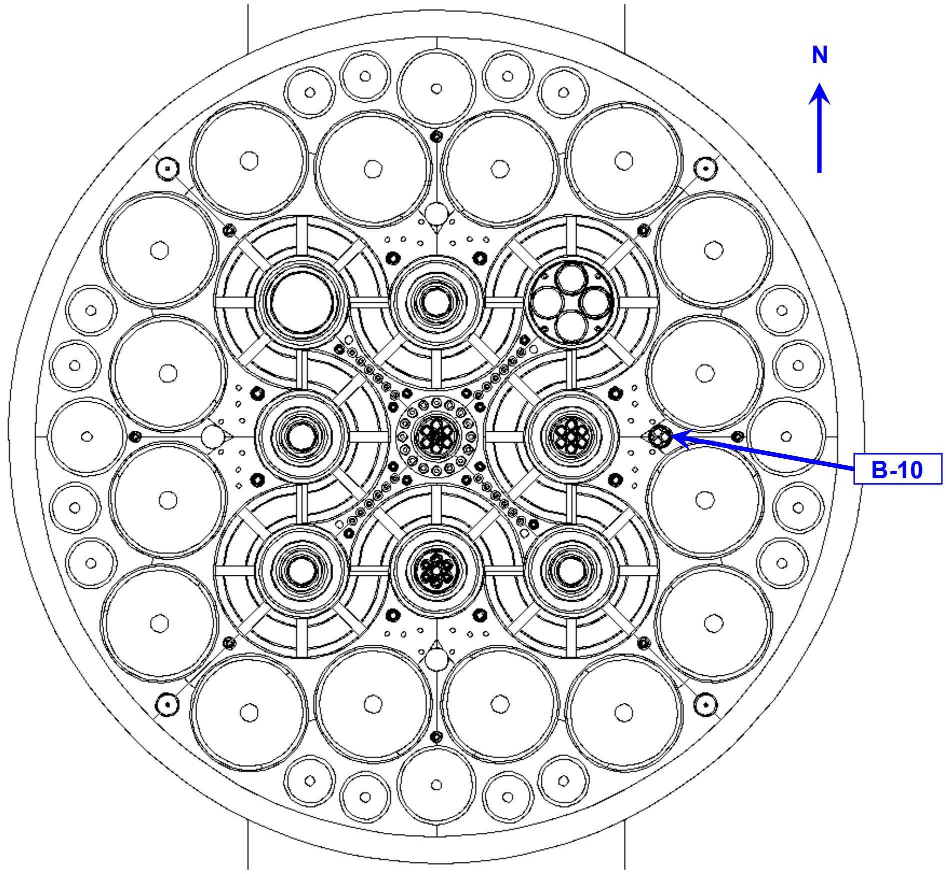


Figure 1. Cross section view of the ATR core, B-10 irradiation test position.

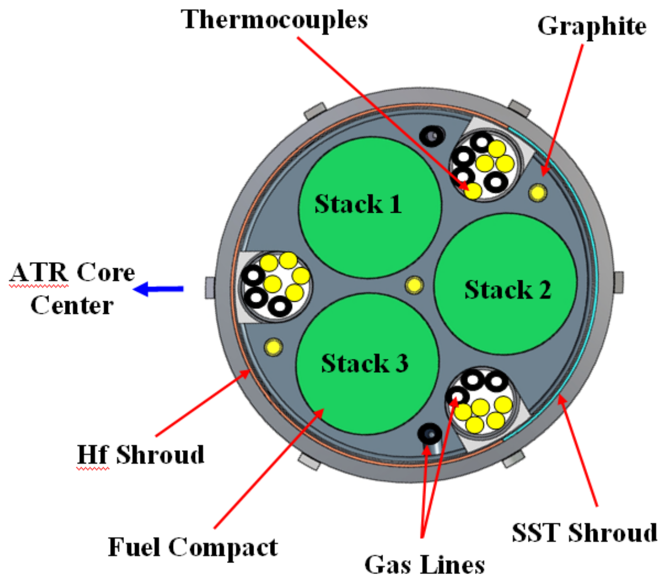


Figure 2. Schematic of cross section of an AGR-1 capsule.

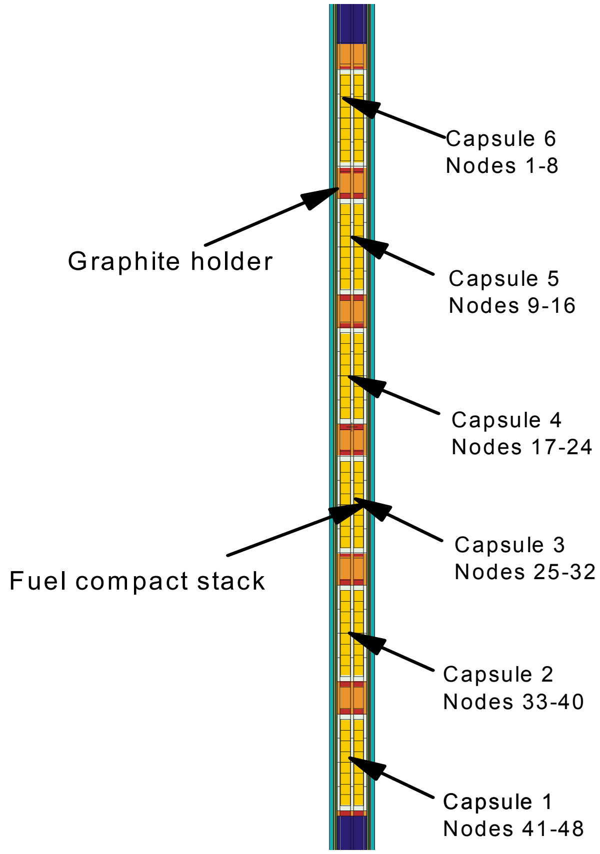


Figure 3. Axial cross-section view of the six capsules in an AGR-1 experiment capsule assembly.

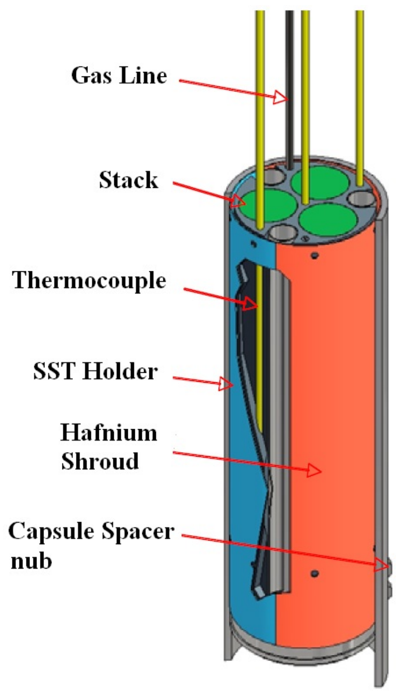


Figure 4. Three-dimensional (3-D) cutaway rendering of single AGR-1 capsule.

DESIGN OR TECHNICAL PARAMETER INPUT AND SOURCES

This analysis is a follow on of Reference [1].

RESULTS OF LITERATURE SEARCHES AND OTHER BACKGROUND DATA

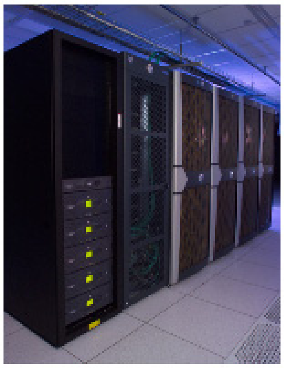
INL Drawing	Revision	Drawing Title
DWG-628633	3	ATR Advanced Gas Reactor (AGR) AGR-1 Capsule Train Assembly and Details
DWG-628635	5	ATR Advanced Gas Reactor (AGR) AGR-1 Capsule Details and Assemblies

ASSUMPTIONS

1. All model dimensions are as-built AGR-1 experiment dimensions and are taken to be the AGR-1 experiment in-reactor “hot” dimensions, with the exceptions noted below.
2. Gap between hafnium/stainless-steel filler is assumed to be closed because of thermal expansion.
3. Gap between stainless-steel retainer and hafnium/stainless-steel filler is assumed to be 0.001-in. at hot temperature. Thermal gap conductance for this gap is taken as 10-times that of pure helium because of unknown contact and dimensions/tolerances of retainer and surrounding parts.
4. Compact heat rates were taken from Reference [3].
5. Heat rates for nongraphite components are taken from Reference [3]. These vary by 1.0-in. increments for the graphite holders in each capsule
6. Graphite component heat rates are taken from as-run physics analysis reported in Reference [3]
7. Graphite and compact thermal conductivity vary with fluence and temperature.
8. Gas mixture thermal conductivity is correlated by kinetic theory of gases using pure gas properties of helium and neon to determine mixture properties.
9. Heat transfer through gas is by conduction and radiation only; no advection.
10. Radiation heat transfer occurs from the graphite holder to the stainless-steel retainer, graphite holder to thru tubes, and thru tubes to stainless-steel retainer. An emissivity of 1.0 was assumed for the graphite, thru tubes, and stainless-steel retainer.
11. There is no axial heat conduction from one capsule to the next. Water inlet temperatures for each capsule increases as water flows through the core from Capsule 6 to Capsule 1. These temperatures for Capsule 6 to Capsule 1 are: 125, 128, 132, 136, 140, and 143°F (52, 53, 56, 58, 60, and 62°C) respectively.
12. Control gas gaps and compact-graphite holder gas gaps change linearly with time during the analysis. The post irradiation examination of the graphite holders and compacts reported in Reference [4] were used for the final gaps. Thermal conductivity of gas mixture is ratioed by the starting gap divided by the time varying gap.

COMPUTER CODE VALIDATION

ABAQUS Version 6.8-2 was used to do the mesh creation, boundary conditions, solving, and post processing. The computer named Icestorm was used to run ABAQUS. Appendix A is the validation report of ABAQUS Version 6.8-2 run on Icestorm. The report is comprised of 10 thermal models validating different aspects of ABAQUS’ heat transfer abilities. The maximum difference between ABAQUS calculated values and exact theoretical values is just under 2.0%. Many of the test problems have 0% error. For the main AGR-1 daily capsule calculations, each run was done with four CPUs running in parallel. The average run took approximately 1.3 hours of wall clock.



Icestorm

- SGI Altix ICE 8200 distributed memory blade cluster
- 256 compute blades with two quad core Intel Xeon processors each
- 2,048 compute cores total, 2.66 GHz clock speed
- 2 login nodes, each with 8 cores
- 2 GB memory per core, 4 TB memory total
- DDR 4X InfiniBand interconnect network
- Operating System: SUSE Linux Enterprise Server 10
- 70 TB disk capacity

MODEL DESCRIPTION

Figures 5 through 19 are used in the description of the model. The finite element mesh is discussed first, followed by a description of the material properties, and ending with the volumetric heat rates imposed on the model.

Finite Element Mesh

Figure 5 shows the finite element mesh with a cutaway view of the entire model. About 350,000 eight-noded hexahedral brick elements were entirely used in all the models. A set of diffusion-convection elements was used to model the flow of the water. All other elements were modeled solely for diffusion heat transfer. Four small areas shown in Figure 5 have an unstructured mesh. These areas exist since a “cross” was placed on the meshing surface where the thermocouples (TCs) are located, thus ensuring an exact x-y location of the TCs. Figure 6 shows a zoomed-in view of the model with colored element set entities. Figure 7 shows a sideways cutaway view of a typical capsule. The beryllium reflector, water channel, pressure boundary, hafnium shroud, and stainless-steel filler were all modeled at 6.1-in. long. The length of these components has a minimal effect on the water temperature rise.

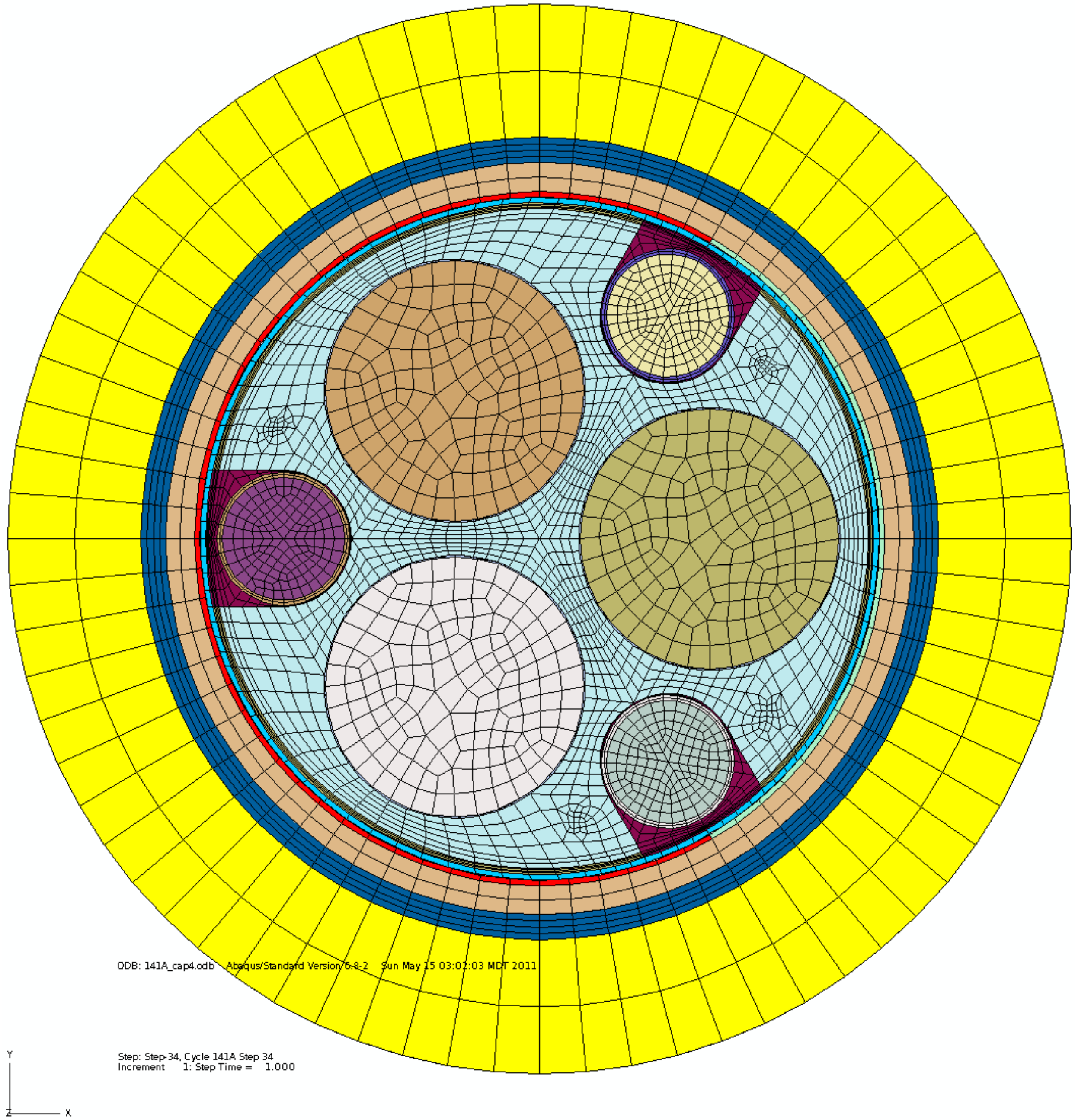


Figure 5. Cross section view of Capsule 4 finite element mesh.

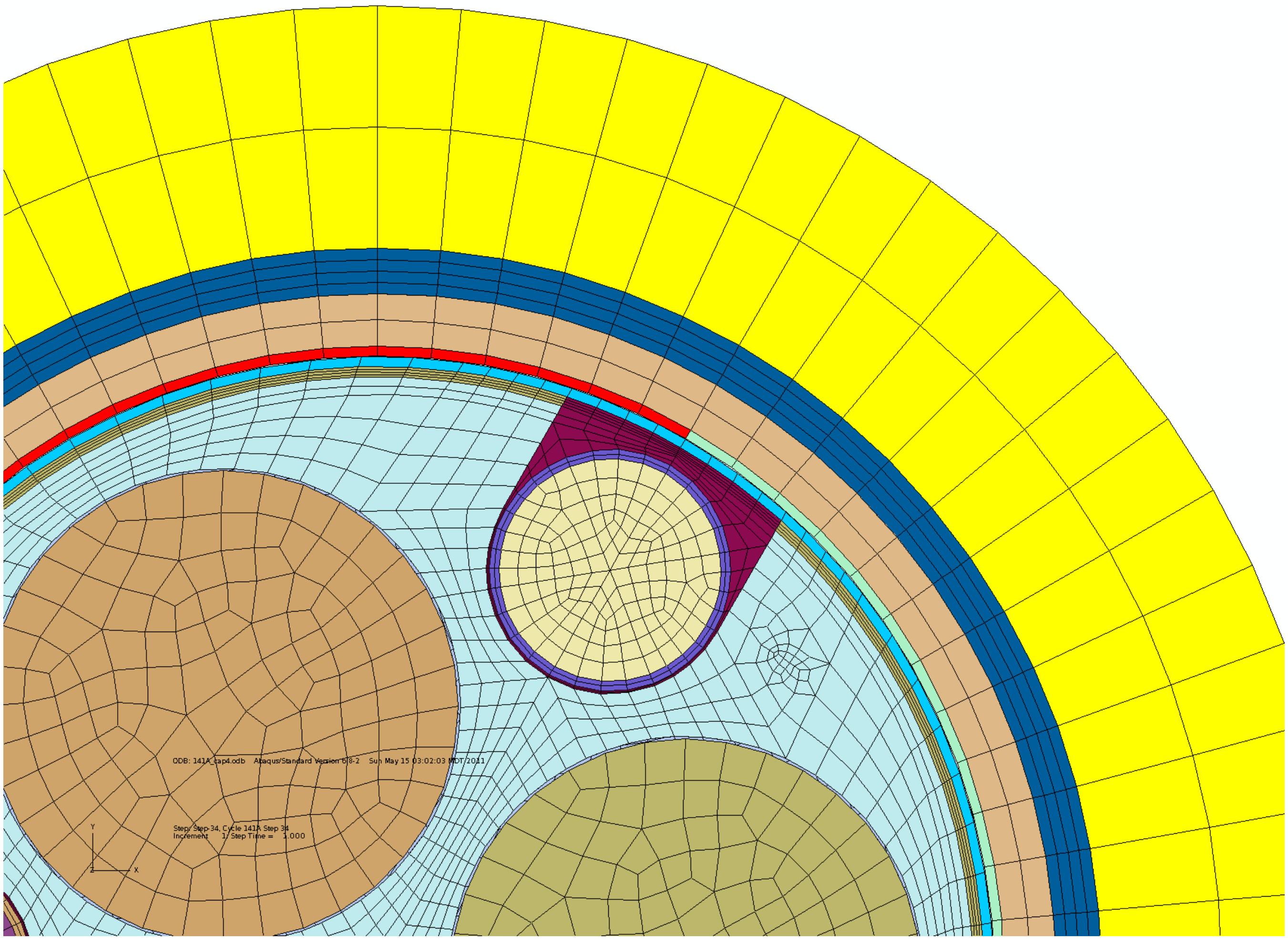


Figure 6. Zoomed in view of colored mesh with different entities.

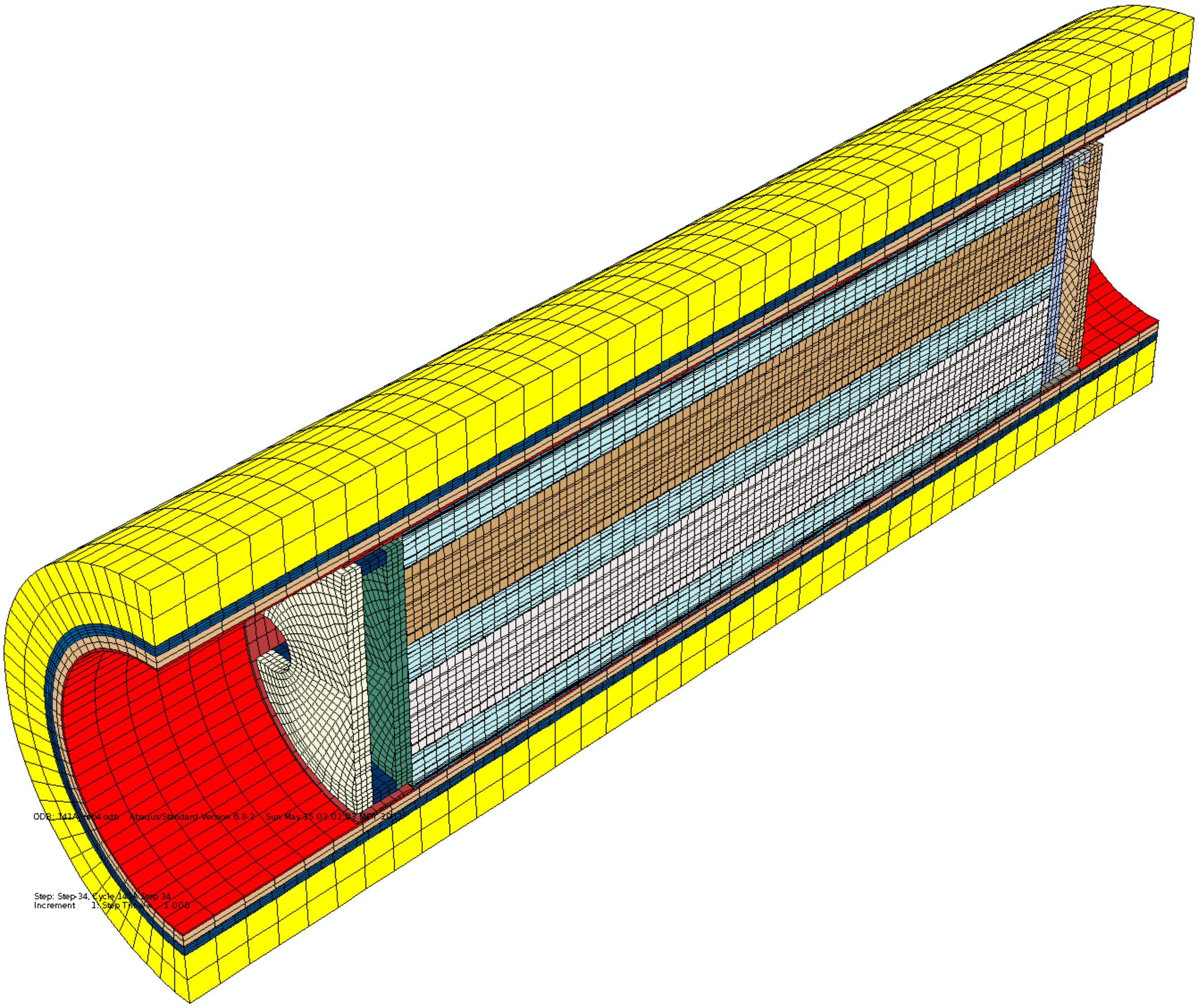


Figure 7. Sideways cutaway view of mesh with colored entities.

The graphite holder and fuel compacts were modeled as 4-in. in length, but most of the heat comes from the compacts and not from the outer components. The water is the ultimate heat sink for each capsule. For the inner part of the model, the graphite holder with its two end-cap spacers and ring were modeled. Previous models discussed in Reference [1] included the components on the top and bottom of the holder such as the stainless-steel head and grafoil. This present model did not include these components since they do not affect the temperatures of the compacts or TC locations. A radiation boundary sink temperature of 400°F (204.4°C) is placed on the top and bottom of each graphite end cap. This value came from previous models in Reference [1] for typical operating conditions.

Figure 8 shows a zoomed-in cutaway view of a typical capsule near the top of the model. This area shows the graphite end caps and graphite ring.

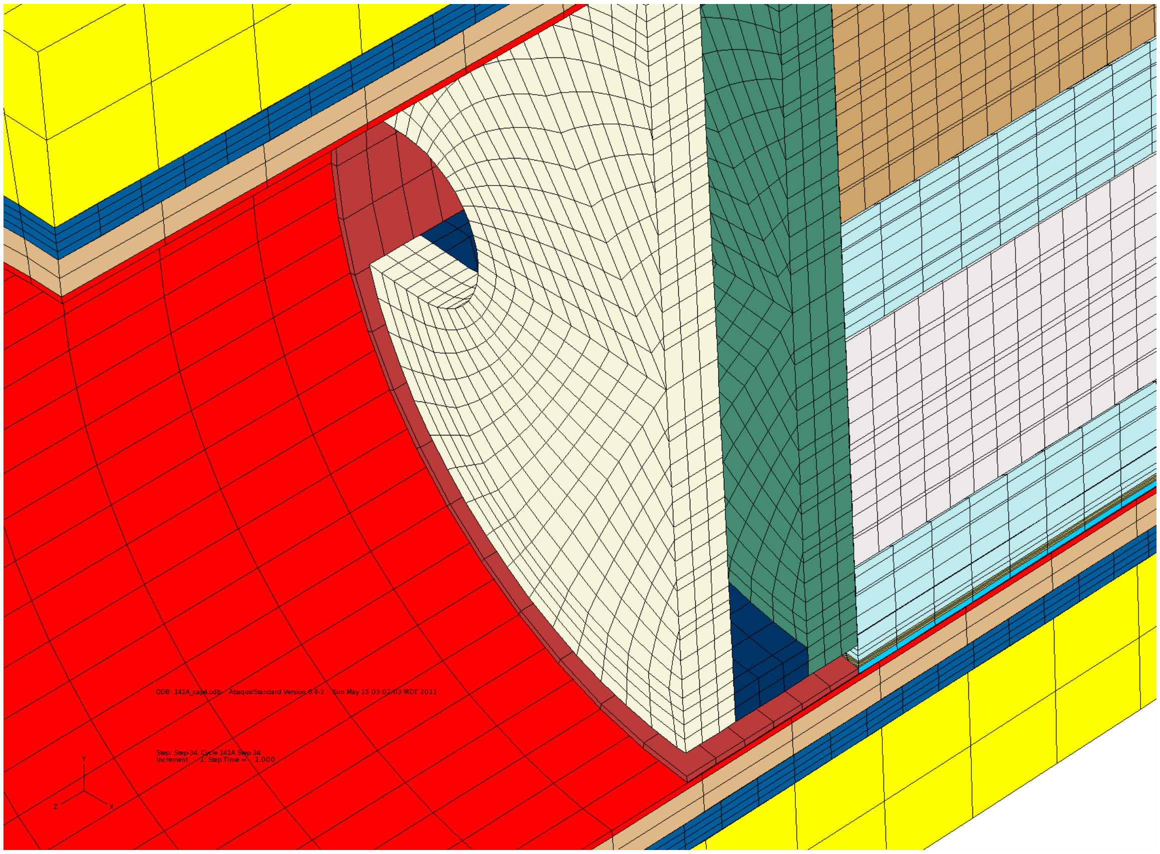


Figure 8. Zoomed in view of top of capsule with sideways cutaway view.

Fuel Compact Thermal Conductivity

The fuel compact thermal conductivity was taken from correlations presented from Gontard [5], which gives correlations for conductivity, taking into account: temperature, temperature of heat treatment, neutron fluence, and TRISO-coated particle packing fraction. In this work, the convention used to quantify neutron damage to a material is fast fluence E >0.18 MeV, yet in the work by Gontard [5], the unit used was the dido nickel equivalent (DNE). In order to convert from the DNE convention to the fast fluence >0.18 MeV, the following conversion was used:

$$\Gamma_{>0.18\mathrm{MeV}} = 1.52\ \Gamma_{\mathrm{DNE}} \quad (1)$$

where Γ is neutron fluence in either the >0.18 MeV unit or DNE. The correlations in the report by Gontard [5] were further adjusted to account for differences in fuel compact density. The correlations were developed for a fuel compact matrix density of 1.75 g/cm^3, whereas the compact matrix used in AGR-1 had a density of approximately 1.3 g/cm^3. The thermal conductivities were scaled according to the ratio of densities (0.74) in order to correct for this difference.

Figure 9 shows a 3-D plot of the fuel compact thermal conductivity varying with fluence and temperature. For fluences greater than 1.0×10^{25} neutrons/m^2 (E > 0.18 MeV), the conductivity increases as fluence increases for higher temperatures, while the opposite occurs at lower temperatures. This is because of the annealing of radiation-induced defects in the material with high temperatures.

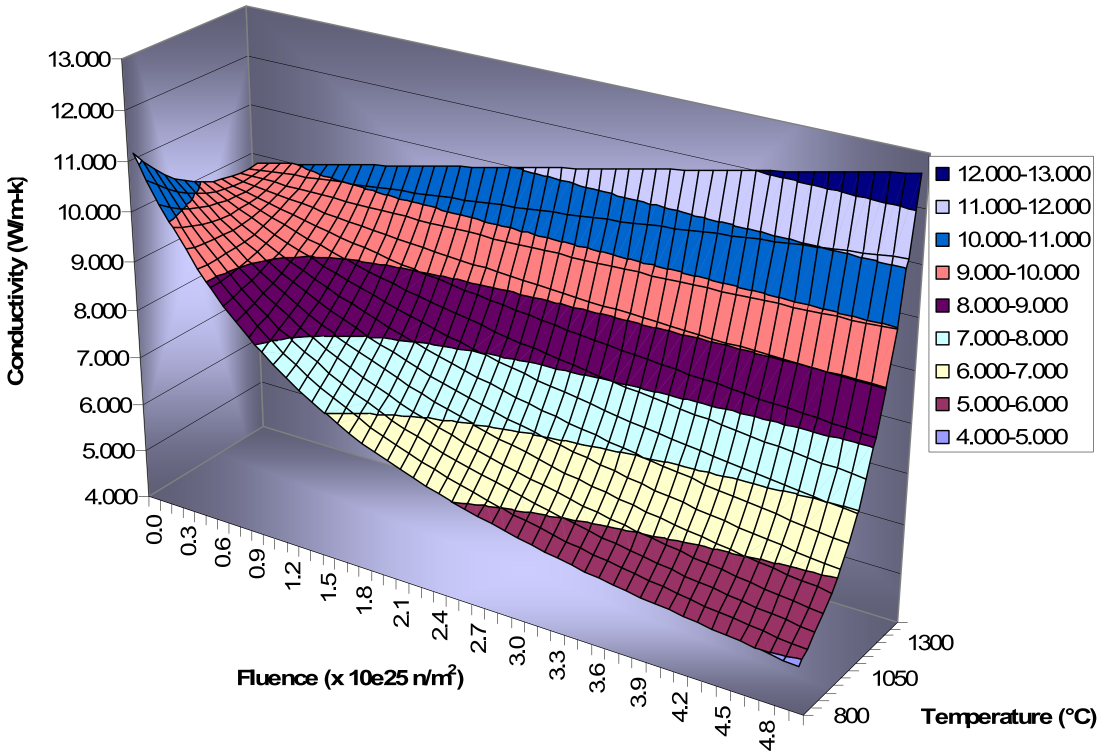


Figure 9. 3-D plot of fuel compact thermal conductivity varying with fluence and temperature.

Graphite Thermal Conductivity

Unirradiated graphite thermal conductivity data for the holders were provided by GrafTech [6]. Figure 10 shows unirradiated thermal conductivity of four different types of boronated graphite. The percentages indicate the weight percent (wt%) boron present in the material. The 5.5% against grain (AG) was used in the holders for Capsules 1 and 6, while the 7% AG was used in Capsules 2–5. The higher boron content was placed in the interior capsules (2–5) as these locations experience a greater thermal neutron flux than the two outer capsules (1 and 6) and the higher boron content provided a flatter compact heating profile through the irradiation. The types of graphite used are indicated with arrows in the legend of Figure 10.

The effect of irradiation on the thermal conductivity of the graphite was accounted for in this analysis using the following correlation by Snead in Reference [7]:

$$\frac{k_{irr}}{k_0} = (0.25 - 0.00017 * T_{irr}) * A * \log(dpa) + 0.000683 * T_{irr}$$

$$A = -1.0 \qquad (2)$$

where k_0 and k_{irr} are thermal conductivity of unirradiated and irradiated graphite respectively, T_{irr} is the irradiation temperature (°C), and dpa is displacements per atom. The multiplier used to convert fast fluence (>0.18 MeV) to dpa is 8.23×10^{-26} dpa/(n/m²) and comes from Sterbentz [8]. Figure 11 shows a 3-D plot of this ratio k_{irr}/k_o varying with dpa and temperature. The ratio of unirradiated to irradiated thermal conductivity increases for higher temperatures and decreases for higher dpa.

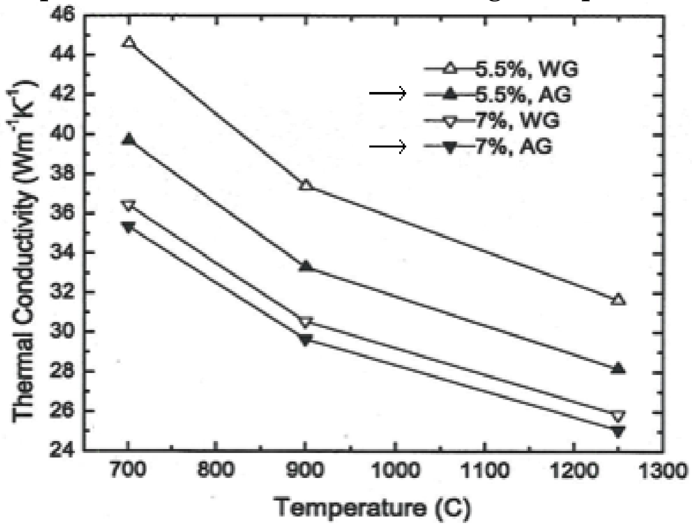


Figure 10. Thermal conductivity of unirradiated, boronated graphite holders [6].

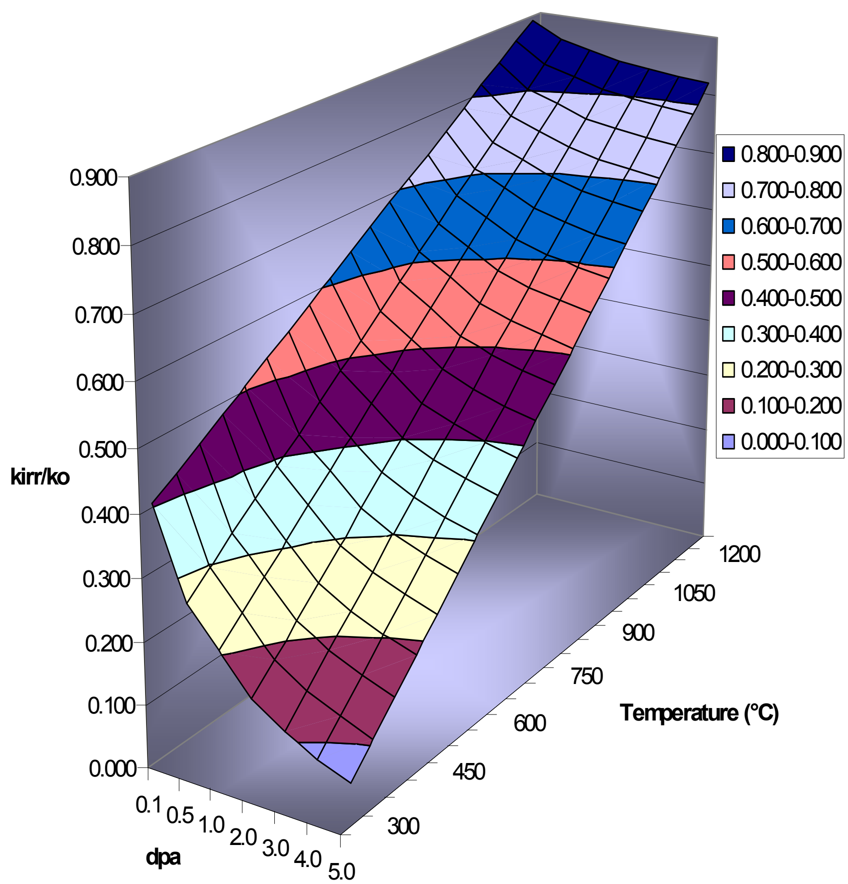


Figure 11. Graphite thermal conductivity plot of ratio of irradiated over unirradiated (k_{irr}/k_o) varying with temperature and dpa.

Gas Mixture Thermal Conductivity

Heat produced in the fuel compacts is transferred through the gas gaps surrounding the compacts into the graphite holder via a gap conductance model using the gap width and the conductivity of the sweep gas as discussed below. Heat is transferred across the outer sweep gas flow region between the outside of the graphite holder and the inside of the stainless-steel liner via radiation between the two surfaces and conduction through the helium/neon sweep gas. Because the thermal capacitance of the sweep gas is very low, advection is not considered in the sweep gas but is modeled as stationary.
The thermal conductivity of the sweep gas was determined using the kinetic theory of gases used by the commercial CFD code FLUENT [9], which gives conductivity k of a gas mixture as a function of the gas constituents i and j according to

$$k = \sum_i \frac{Y_i k_i}{\sum_j Y_j \phi_{ij}} \tag{3}$$

where Y_i is the mole fraction of gas i and k_i is the thermal conductivity of pure gas i. The parameter Φ_{ij} in Eq. 3 is given by

$$\phi_{ij} = \frac{\left[1 + \left(\frac{\mu_i}{\mu_j}\right)^{1/2} \left(\frac{MW_j}{MW_i}\right)^{1/4}\right]^2}{\left[8\left(1 + \frac{MW_j}{MW_i}\right)\right]^{1/2}} \tag{4}$$

where μ_i is the viscosity of pure gas i and $M_{w,i}$ is the molecular weight of pure gas i. Pure gas properties were taken from Toulukian [10]. Figure 12 plots the resulting helium/neon sweep gas thermal conductivity versus temperature and mole fraction of helium. The thermal conductivity increases as the helium mole fraction increases and as the temperature increases. Appendix B shows the material properties used in the ABAQUS models in a tabular form.

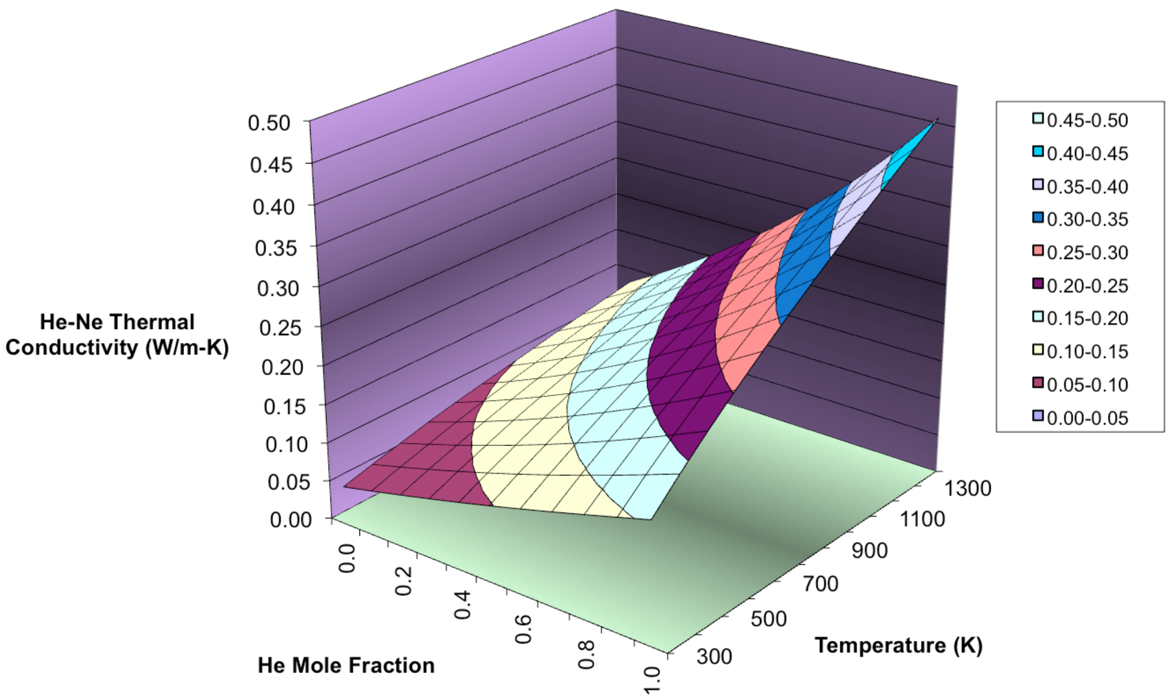


Figure 12. Sweep gas thermal conductivity versus temperature and mole fraction helium.

Conduction and Radiation Heat Transfer

The governing equation of steady-state heat transfer for the model is taken as

$$\rho c_p\left(u_x\frac{\partial T}{\partial x}+u_y\frac{\partial T}{\partial y}+u_z\frac{\partial T}{\partial z}\right)=\frac{\partial}{\partial x}\left(k(T)\frac{\partial T}{\partial x}\right)+\frac{\partial}{\partial y}\left(k(T)\frac{\partial T}{\partial y}\right)+\frac{\partial}{\partial z}\left(k(T)\frac{\partial T}{\partial z}\right)+Q \quad (5)$$

where ρ is the density, c_p is the specific heat, u_x, u_y, and u_z are the three directional velocities, T is temperature, x, y, and z are directions, $k(T)$ is the thermal conductivity varying with temperature, and Q is the heat source. The velocity of the water (u_z) was taken from Ambrosek's work [1]. The gas gaps between the graphite holder and the stainless-steel-retainer sleeve used above mentioned gas mixture conductivity correlation and were modeled with solid eight-noded brick elements with diffusion heat transfer. Conduction heat transfer across gas gaps using the ABAQUS *Gap Conductance model was implemented on the gaps between the following surface pairs followed by gap distance:

- Fuel compacts and graphite holder (starts at 0.0025 in., varies with time)
- Bottom and top graphite spacers with stainless steel retainer sleeve (0.038 in)
- Bottom and top graphite rings with stainless steel retainer sleeve (0.038 in)
- Graphite spacers with graphite spacers on top and bottom (0.125 in).

The governing equation for radiation heat transfer across the gas gaps is taken as

$$q_{net} = \frac{\sigma\left(T_1^4 - T_2^4\right)}{\frac{(1-\varepsilon_1)}{\varepsilon_1 A_1} + \frac{1}{A_1 F_{12}} + \frac{(1-\varepsilon_2)}{\varepsilon_2 A_2}} \tag{6}$$

where q is the net heat flux, σ is the Stephan Boltzmann constant, T_1 and T_2 are the surface temperatures, ε_1 and ε_2 are the emissivities of surfaces 1 and 2, A_1 and A_2 are the areas of surfaces 1 and 2, and F_{12} is the view factor from surface 1 to 2.
Radiation heat transfer using the ABAQUS *Gap Radiation model was implemented on the following surface pairs:

- Graphite holder with stainless steel retainer sleeve
- Graphite holder with thru tubes
- Thru tubes with stainless steel retainer sleeve
- Bottom and top graphite spacers with stainless steel retainer sleeve
- Bottom and top graphite rings with stainless steel retainer sleeve
- Graphite spacers with graphite spacers on top and bottom.

A surface radiation boundary condition using the ABAQUS *Surface Radiation model was placed on the top of the top graphite spacer and the bottom of the bottom graphite spacer and radiated to an infinite medium of 400°F (204.4°C). In order to calibrate the finite element thermal model, the emissivities of the outer surface of the graphite holder and the inner surface of the stainless-steel sleeve were adjusted such that predicted and measured TC temperatures agreed as closely as possible early in the irradiation before TC drift had become important. View factors for each surface pair were set at 1.0. Emissivity values of 1.0, and 0.99 for all surfaces gave best agreement between calculation and measurements. In fact, during assembly of the test, the presence of graphite dust was noted on these surfaces, which would serve to raise the emissivities of these surfaces to values closer to their maximum possible value of 1.0. Inspection of the test train during PIE may provide more insight into possible physical realization of these high emissivities.

Daily Gas Mixtures

The daily gas mixtures were taken from NGNP Management and Analysis System (NDMAS) data; NDMAS logs all of the data for the AGR-1 experiment. A sampling of data for Capsules 6 and 5 during Cycle 143B are shown in Figure 13. Data in the NDMAS system provides a separate flow rate for helium and neon for each capsule. Data taken from ATR shows that these gas flow rate values were taken every 5 minutes. These values were averaged by NDMAS to get a daily average. The green columns were used in the ABAQUS model for each capsule for each day as they show the fraction of gas that is neon. The leadout gas was helium through May 29, 2009; it was then switched to neon for the rest of the experiment. Since the summation of the flows of helium and neon for each capsule do not add up to the total flow rate for each capsule, it was assumed that the leadout gas made up the difference. For example, on the day of Feb 5, 2009, for Capsule 6 when helium flow was 4.505, neon flow was 25.47, and total flow was 35.134, the neon fraction was taken as 25.470/35.134 = 0.725. Appendix C shows the gas mixtures used in

ABAQUS for each day for each cycle. The pink shadowed areas indicate that the reactor scrammed on Jan 19, 2009, then sat for a day with no power (100% helium), then started up again on January 21, 2009. Only gas flow data during the time the reactor was at power was used during these pink shadowed areas. This ensured that the neon fraction was not skewed towards helium as 100% helium was flowed into the capsules immediately at scram and during startup.

Capsule				Leadout				Capsule 6				Capsule 5			
				Avg Q_He	Avg Q_Ne	Avg Q_Total		Avg Q_He	Avg Q_Ne	Avg Q_Total	% Ne	Avg Q_He	Avg Q_Ne	Avg Q_Total	%Ne
Year	Month	Day	ATR Cycle												
2009	1	17	143 B	18	0	18	0.002	0.000	30.000	34.725	0.864	-0.183	30.000	36.413	0.824
2009	1	18	143 B	18	0	18	0.002	0.003	30.071	34.811	0.864	-0.159	30.136	36.493	0.826
2009	1	19	143 B	18	0	18	0.002	30.000	34.655	0.866	0.536	26.116	35.332	0.739	0.575
2009	1	20	143 B	18	0	18	0.002	30.000	0.000	33.044	0.000	30.000	0.000	35.981	0.000
2009	1	21	143 B	18	0	18	0.002	3.080	33.310	0.090	0.915	3.092	35.705	0.087	0.920
2009	1	22	143 B	18	0	18	0.002	0.007	30.000	34.841	0.861	-0.098	30.200	36.691	0.823
2009	1	23	143 B	18	0	18	0.002	0.049	30.066	34.970	0.860	-0.091	30.200	36.762	0.822
2009	1	24	143 B	18	0	18	0.002	0.000	30.100	34.955	0.861	-0.100	30.200	36.764	0.821
2009	1	25	143 B	18	0	18	0.002	0.000	30.100	34.860	0.863	-0.149	30.200	36.630	0.824
2009	1	26	143 B	18	0	18	0.002	0.000	30.100	34.785	0.865	-0.187	30.200	36.541	0.826
2009	1	27	143 B	18	0	18	0.002	0.000	30.100	34.821	0.864	-0.100	30.200	36.569	0.826
2009	1	28	143 B	18	0	18	0.002	0.000	30.100	34.824	0.864	-0.121	30.200	36.564	0.826
2009	1	29	143 B	18	0	18	0.002	0.000	30.100	34.762	0.866	-0.116	30.200	36.551	0.826
2009	1	30	143 B	18	0	18	0.002	0.000	30.100	34.763	0.866	-0.147	30.200	36.577	0.826
2009	1	31	143 B	18	0	18	0.002	0.000	30.100	34.766	0.866	-0.195	30.200	36.581	0.826
2009	2	1	143 B	18	0	18	0.002	0.000	30.100	34.741	0.866	-0.190	30.200	36.560	0.826
2009	2	2	143 B	18	0	18	0.002	0.000	30.100	34.725	0.867	-0.194	30.200	36.566	0.826
2009	2	3	143 B	18	0	18	0.002	1.673	28.361	34.872	0.813	-0.132	30.200	36.530	0.827
2009	2	4	143 B	18	0	18	0.002	3.487	26.507	35.019	0.757	0.408	29.633	36.497	0.812
2009	2	5	143 B	18	0	18	0.002	4.505	25.470	35.134	0.725	0.677	29.364	36.534	0.804
2009	2	6	143 B	18	0	18	0.002	2.302	27.683	34.999	0.791	0.130	30.000	36.679	0.818
2009	2	7	143 B	18	0	18	0.002	2.405	27.594	35.029	0.788	-0.052	30.093	36.587	0.823
2009	2	8	143 B	18	0	18	0.002	3.613	26.387	35.112	0.752	-0.094	30.170	36.541	0.826

Figure 13. Sampling of daily gas mixtures for various capsules taken from NDMAS.

Fluence

Graphite and fuel compact material properties vary with fluence. This was taken as Field Variable 2 in the ABAQUS input model, while the neon fraction was taken as Field Variable 1. Fluence values were taken from as-run predictions given by Sterbentz [3].

Component Heat Rates

The gamma heating for the various components (including the fuel compacts) were taken from Sterbentz [3]. The water heat rate and the beryllium heat rate were included. The heat raises the water temperature as it flows by the capsule, but are only a small fraction of the total heat. The components on the inside of the water had the greatest effect on the temperature of the fuel compacts and TC locations. Table 1 shows the correlation between the physics analysis and the ABAQUS element groups for the component heat generation.

Table 1. Component description and correlation with physics analysis.

MCNP Component Cell No.	Component Description	Capsule No.	(Lower) ATR Core Elevation Range (inches)	(Upper) ATR Core Elevation Range (inches)	ABAQUS Element Group Name
95001	Borated Graphite Holders	6	40.0	40.5	Hold_4_elem
95002	Borated Graphite Holders	6	39.5	40.0	Hold_3_elem
95003	Borated Graphite Holders	6	38.5	39.5	Hold_2_elem
95004	Borated Graphite Holders	6	36.5	38.5	Hold_1_elem
95005	Borated Graphite Holders	5	33.5	34.5	Hold_4_elem
95006	Borated Graphite Holders	5	32.5	33.5	Hold_3_elem
95007	Borated Graphite Holders	5	31.5	32.5	Hold_2_elem
95008	Borated Graphite Holders	5	30.5	31.5	Hold_1_elem
95009	Borated Graphite Holders	4	27.5	28.5	Hold_4_elem
95010	Borated Graphite Holders	4	26.5	27.5	Hold_3_elem
95011	Borated Graphite Holders	4	25.5	26.5	Hold_2_elem
95012	Borated Graphite Holders	4	24.5	25.5	Hold_1_elem
95013	Borated Graphite Holders	3	21.5	22.5	Hold_4_elem
95014	Borated Graphite Holders	3	20.5	21.5	Hold_3_elem
95015	Borated Graphite Holders	3	19.5	20.5	Hold_2_elem
95016	Borated Graphite Holders	3	18.5	19.5	Hold_1_elem
95017	Borated Graphite Holders	2	15.5	16.5	Hold_4_elem
95018	Borated Graphite Holders	2	14.5	15.5	Hold_3_elem
95019	Borated Graphite Holders	2	13.5	14.5	Hold_2_elem
95020	Borated Graphite Holders	2	12.5	13.5	Hold_1_elem
95021	Borated Graphite Holders	1	9.5	10.5	Hold_4_elem
95022	Borated Graphite Holders	1	8.5	9.5	Hold_3_elem
95023	Borated Graphite Holders	1	6.5	8.5	Hold_2_elem and Hold_1_elem
9481	SS Inner Sleeve Capsule	Capsule 6			Ssretain
9482	SS Inner Sleeve Capsule	Capsule 5			Ssretain
9483	SS Inner Sleeve Capsule	Capsule 4			Ssretain
9484	SS Inner Sleeve Capsule	Capsule 3			Ssretain
9485	SS Inner Sleeve Capsule	Capsule 2			Ssretain
9486	SS Inner Sleeve Capsule	Capsule 1			Ssretain
9026	Hf Shoud (Azimuthal section)	Capsule 6	1	above stack 1	Hafnium_1
9027	Hf Shoud (Azimuthal section)	Capsule 5	1	above stack 1	Hafnium_1
9028	Hf Shoud (Azimuthal section)	Capsule 4	1	above stack 1	Hafnium_1
9029	Hf Shoud (Azimuthal section)	Capsule 3	1	above stack 1	Hafnium_1
9030	Hf Shoud (Azimuthal section)	Capsule 2	1	above stack 1	Hafnium_1
9031	Hf Shoud (Azimuthal section)	Capsule 1	1	above stack 1	Hafnium_1
9032	Hf Shoud (Azimuthal section)	Capsule 6	2	infront of stack 1, facing core	Hafnium_2
9033	Hf Shoud (Azimuthal section)	Capsule 5	2	infront of stack 1, facing core	Hafnium_2
9034	Hf Shoud (Azimuthal section)	Capsule 4	2	infront of stack 1, facing core	Hafnium_2
9035	Hf Shoud (Azimuthal section)	Capsule 3	2	infront of stack 1, facing core	Hafnium_2
9036	Hf Shoud (Azimuthal section)	Capsule 2	2	infront of stack 1, facing core	Hafnium_2
9037	Hf Shoud (Azimuthal section)	Capsule 1	2	infront of stack 1, facing core	Hafnium_2
9038	Hf Shoud (Azimuthal section)	Capsule 6	3	infront of stack 3, facing core	Hafnium_3
9039	Hf Shoud (Azimuthal section)	Capsule 5	3	infront of stack 3, facing core	Hafnium_3
9040	Hf Shoud (Azimuthal section)	Capsule 4	3	infront of stack 3, facing core	Hafnium_3
9041	Hf Shoud (Azimuthal section)	Capsule 3	3	infront of stack 3, facing core	Hafnium_3
9042	Hf Shoud (Azimuthal section)	Capsule 2	3	infront of stack 3, facing core	Hafnium_3
9043	Hf Shoud (Azimuthal section)	Capsule 1	3	infront of stack 3, facing core	Hafnium_3
9044	Hf Shoud (Azimuthal section)	Capsule 6	4	below stack 3	Hafnium_4
9045	Hf Shoud (Azimuthal section)	Capsule 5	4	below stack 3	Hafnium_4
9046	Hf Shoud (Azimuthal section)	Capsule 4	4	below stack 3	Hafnium_4
9047	Hf Shoud (Azimuthal section)	Capsule 3	4	below stack 3	Hafnium_4
9048	Hf Shoud (Azimuthal section)	Capsule 2	4	below stack 3	Hafnium_4
9049	Hf Shoud (Azimuthal section)	Capsule 1	4	below stack 3	Hafnium_4
9050	SS Shroud section (120 deg)	Capsule 6			SSShroud
9051	SS Shroud section (120 deg)	Capsule 5			SSShroud
9052	SS Shroud section (120 deg)	Capsule 4			SSShroud
9053	SS Shroud section (120 deg)	Capsule 3			SSShroud
9054	SS Shroud section (120 deg)	Capsule 2			SSShroud
9055	SS Shroud section (120 deg)	Capsule 1			SSShroud
9507	Outer Capsule Wall	Average over the full length of six capsules			Pbond
9368	ATR Coolant H2O	Average over the full length of six capsules			Water
17301	Top Graphite Spacer	Capsule 6			Top_Spacer
17311	Bottom Graphite Spacer	Capsule 6			Bot_Spacer
17302	Top Graphite Spacer	Capsule 5			Top_Spacer
17312	Bottom Graphite Spacer	Capsule 5			Bot_Spacer
17303	Top Graphite Spacer	Capsule 4			Top_Spacer
17313	Bottom Graphite Spacer	Capsule 4			Bot_Spacer
17304	Top Graphite Spacer	Capsule 3			Top_Spacer
17314	Bottom Graphite Spacer	Capsule 3			Bot_Spacer
17305	Top Graphite Spacer	Capsule 2			Top_Spacer
17315	Bottom Graphite Spacer	Capsule 2			Bot_Spacer
17306	Top Graphite Spacer	Capsule 1			Top_Spacer
17316	Bottom Graphite Spacer	Capsule 1			Bot_Spacer

Heat generation rates for the thru tubes and material inside the thru tubes were taken as a fraction of the stainless-steel retainer heat rate for each capsule for each day. The multiplying factors used were 0.83, 0.69, and 0.69 for the material inside the thru tubes for the ABAQUS element groups Intub1, Intub2, and Intub3 respectively. The multiplying factors for the thru tubes themselves for Tubes 1, 2, and 3 are 1.65, 1.38, and 1.38 respectively.

Figure 14 shows the daily component heat rates versus effective full-power days (EFPDs) for each cycle of the AGR-1 experiment. The blue lines show the graphite heat rates decreasing during the experiment because of the boron being burned up. Figure 15 shows the daily graphite heat rates for the graphite components. Figure 16 shows the heat rates for the hafnium sleeve versus EFPDs. Figure 17 shows the component heat rates for the three different thru tubes and the inside of the thru tubes as a function of EFPD.

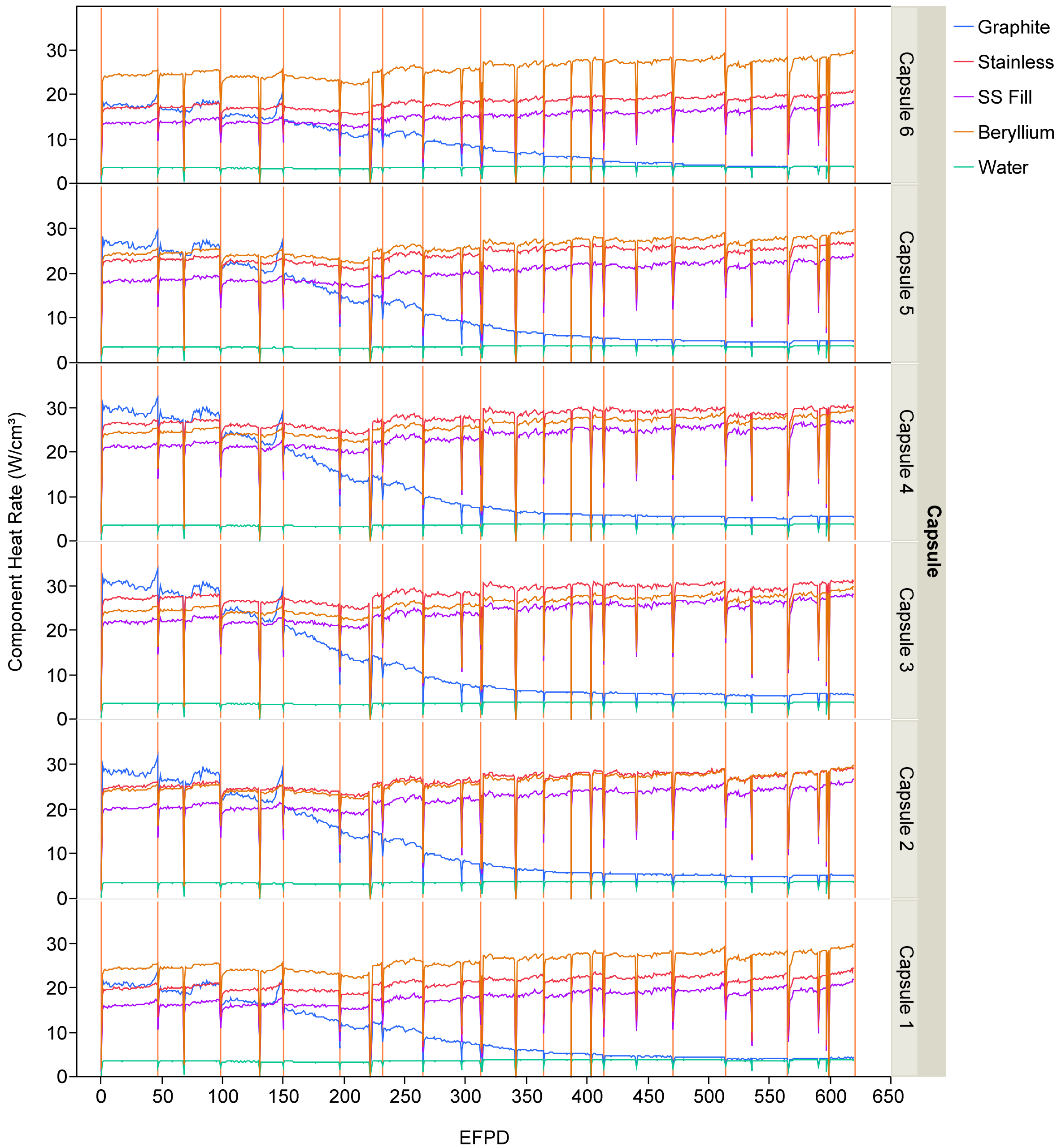


Figure 14. Various daily component heat rates versus EFPD.

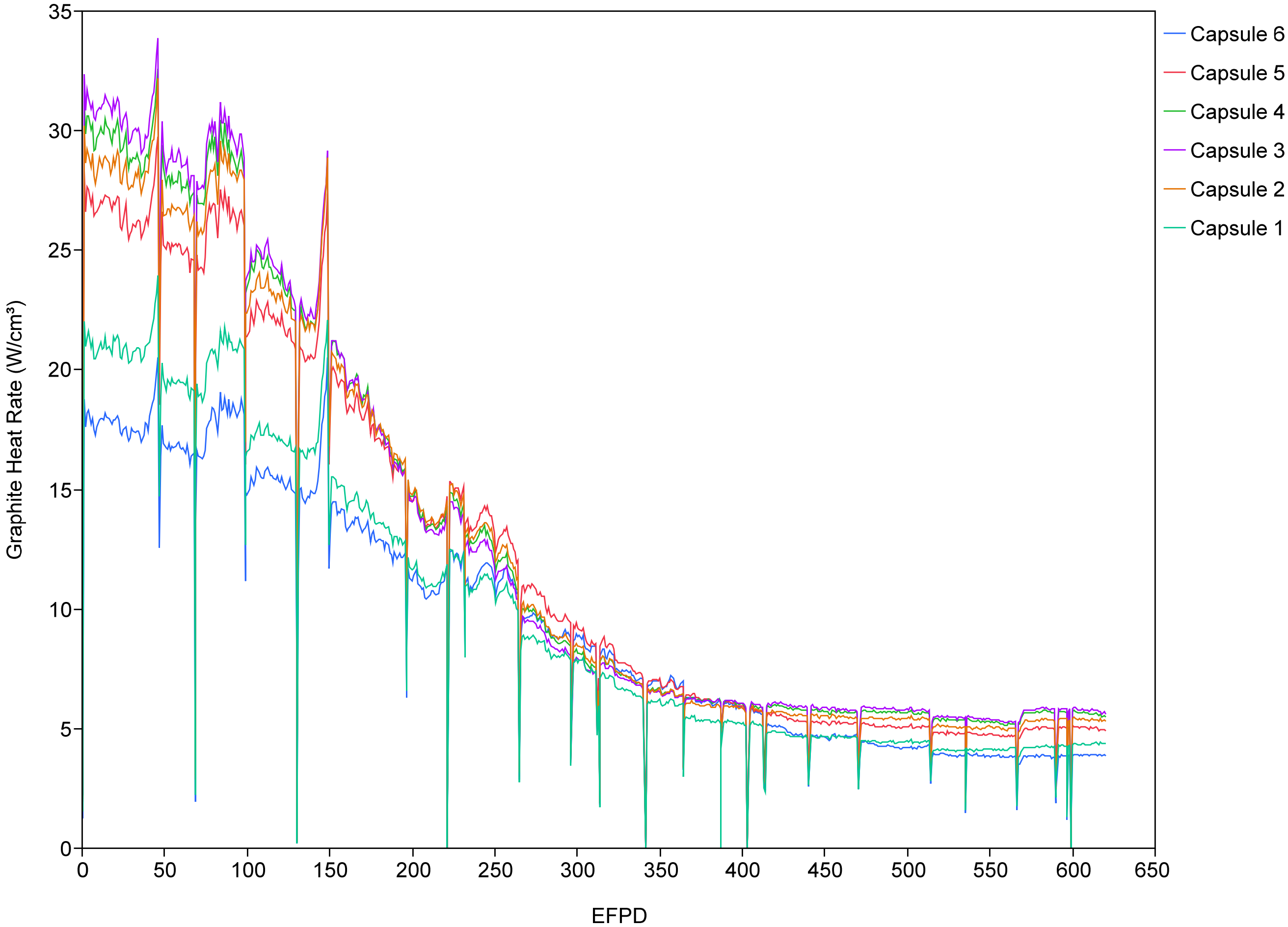


Figure 15. Daily graphite heat rates versus EFPD.

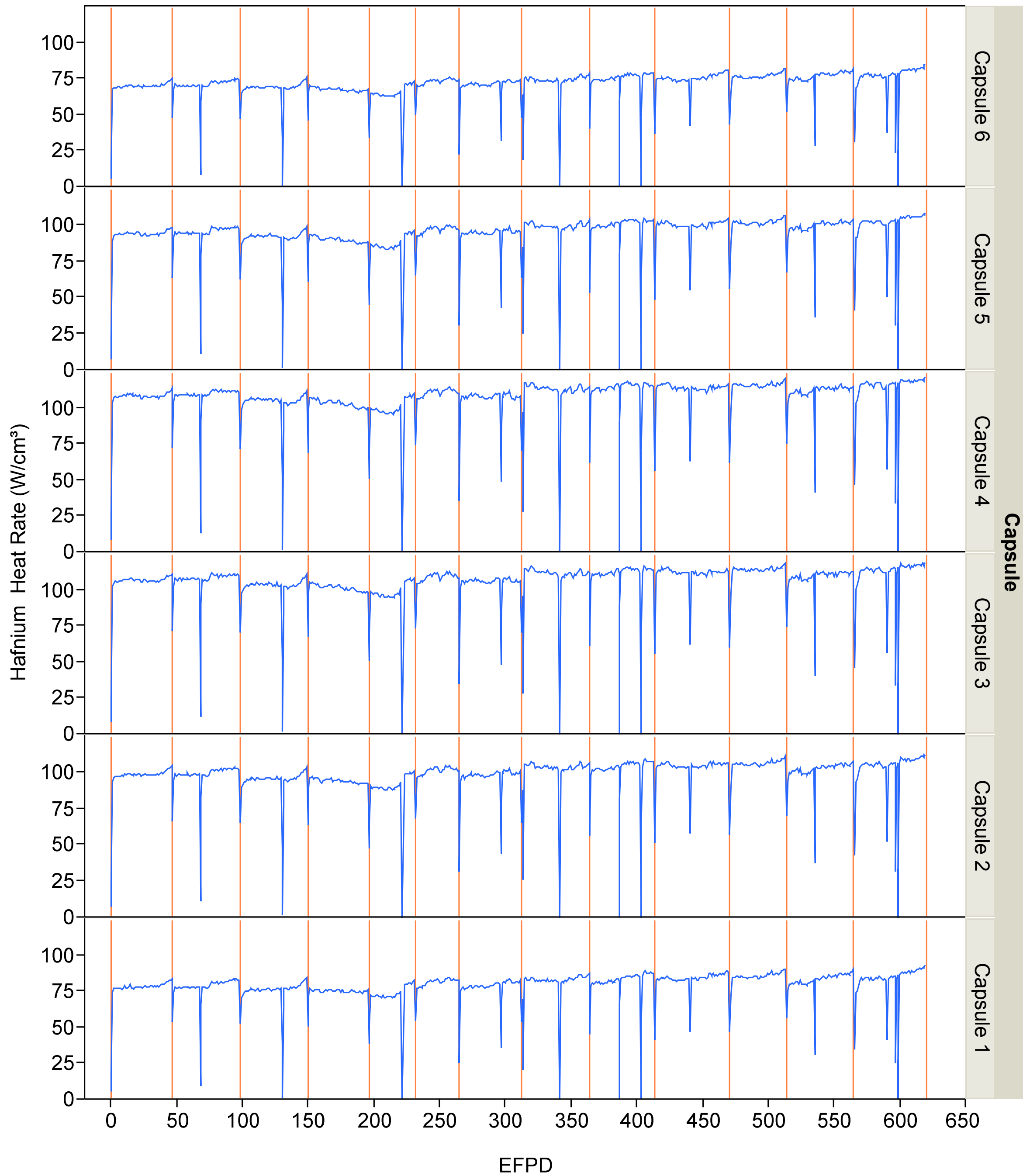


Figure 16. Daily hafnium heat rates versus EFPD.

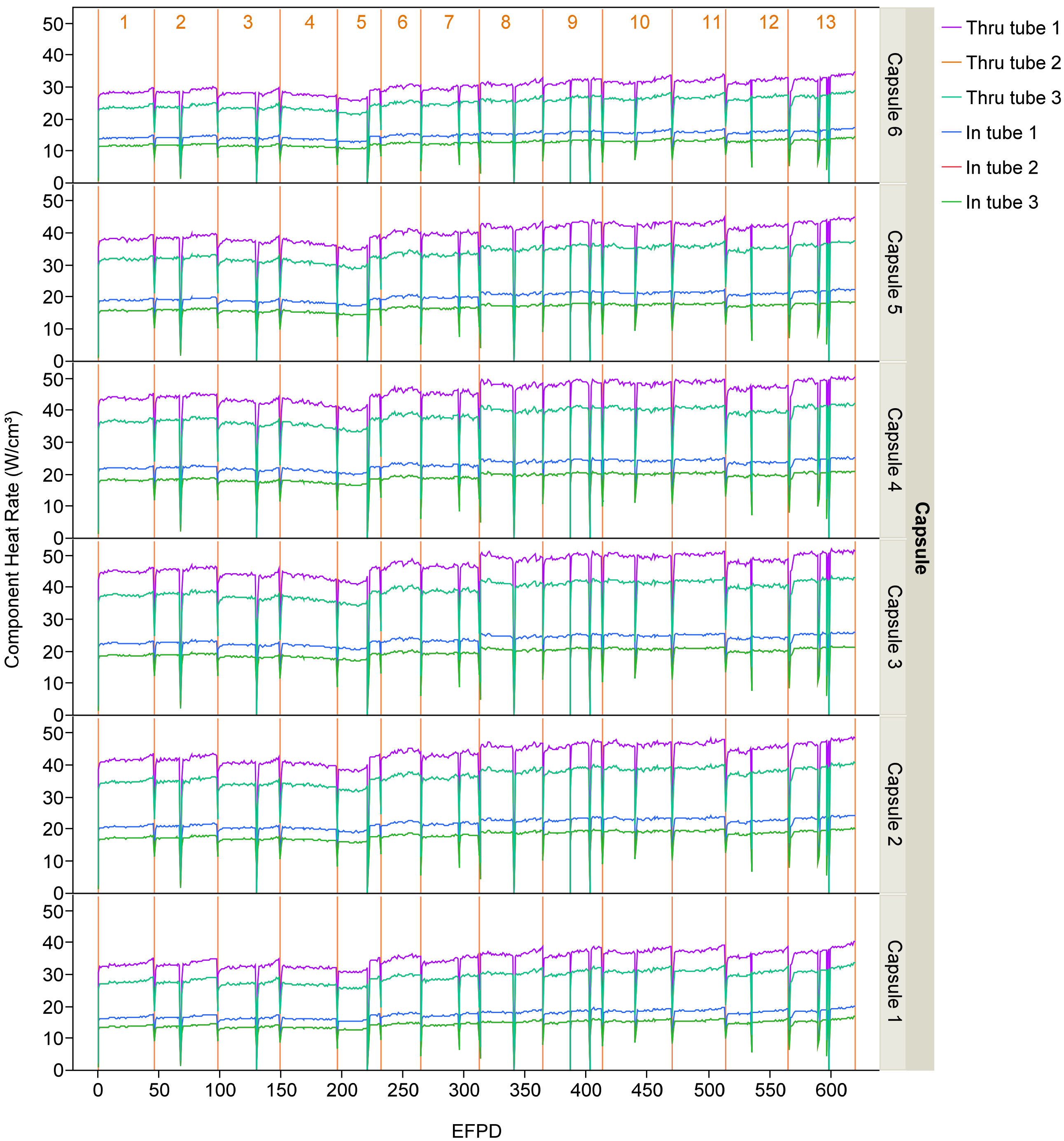


Figure 17. Daily component heat rates versus EFPD for thru tubes and inside thru tubes.

Fuel Compact Heat Rates

Fuel compact heat rates were taken from Sterbentz [3]. The ABAQUS model and the MCNP model used to do the physics calculations use the exact same volumes for the fuel compacts. The heating volumes in ABAQUS were described with element groups matching one-half of each compact split at the midpoint from top to bottom. These one-half fuel compact heat rates were input into the ABAQUS input file for each day for each cycle. Figure 18 shows the daily average fuel compact heat rates for each capsule versus EFPDs for the entire AGR-1 experiment. Fuel compact heat rates peak during Cycle 141A (sixth cycle). A sharp spike in heat occurs at the end of the third cycle (139B) because of the outer shim control cylinders (OSCC) drastic rotation. The same heat rate data is shown in Figure 19, but is all plotted on the same axis with a smoothing function in the plotting software.

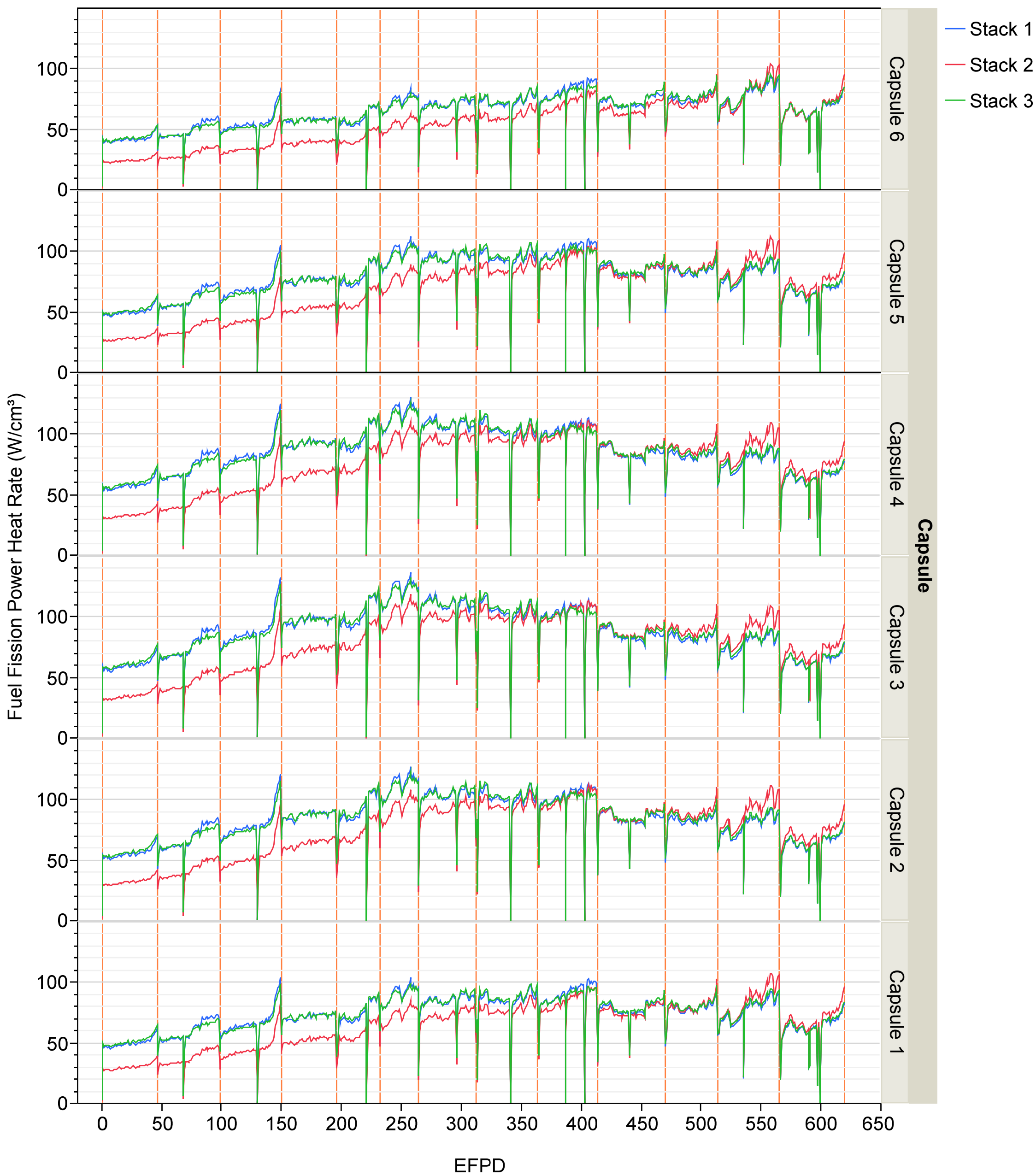


Figure 18. Daily capsule average volumetric heat rates for fuel compacts versus EFPD.

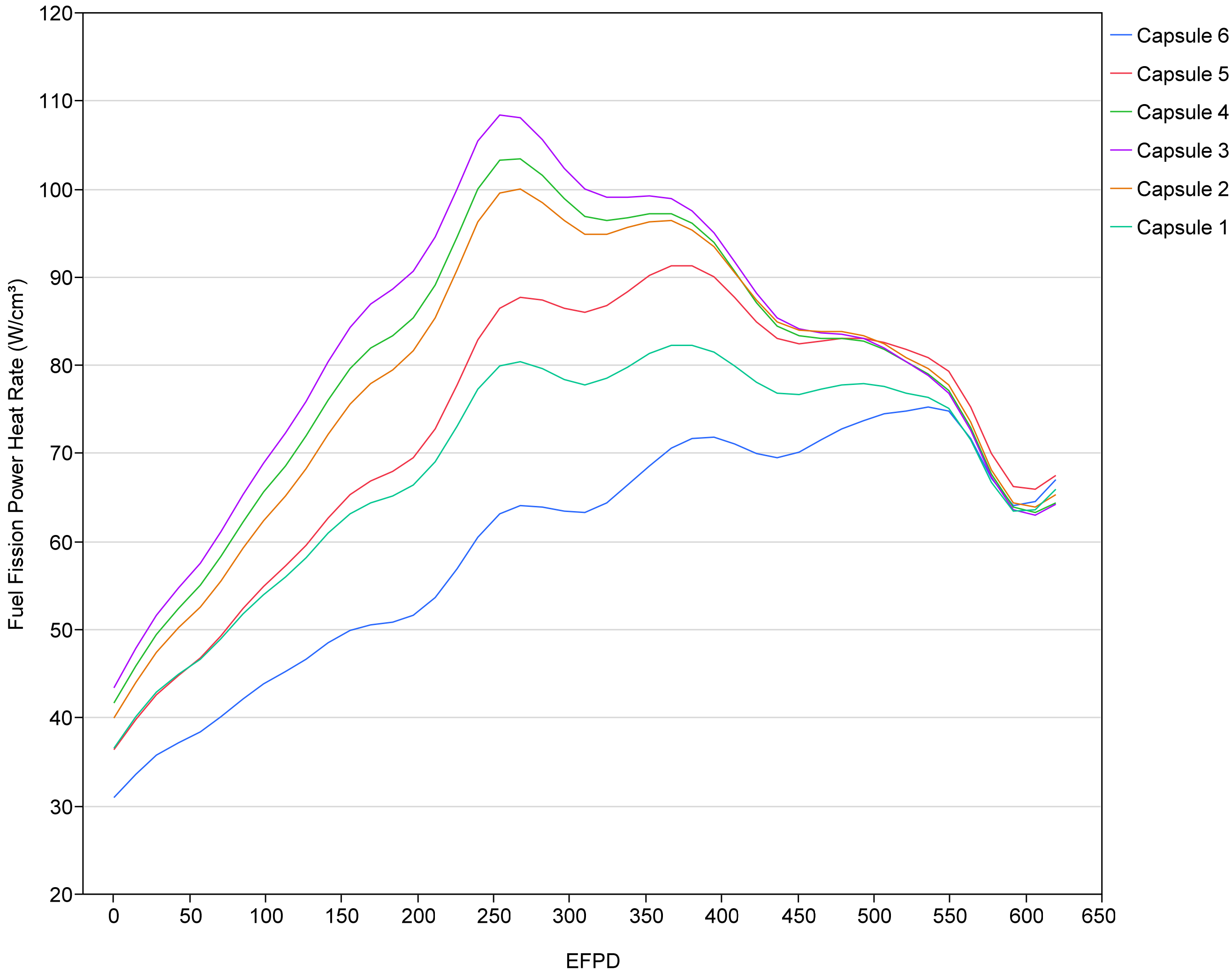


Figure 19. Smooth plot of daily capsule average volumetric heat rates in compacts versus EFPD.

Water Boundary Conditions

Separate water inlet temperatures were used for each capsule. Boundary inlet temperatures for Capsules 6–1 were 125, 128, 132, 136, 140, and 143°F (52, 53, 56, 58, 60, and 62°C) respectively. These temperature inlet conditions match within 1°F of the calculated temperatures discussed in the Results section. A water flow rate (taken from Ambrosek [1]) of 8.1 lb/(s-in^2) was used in all models. A heat transfer coefficient between the water and its surroundings of 0.00694 Btu/(s-in^2-°F) was also implemented and taken from Ambrosek [1].

Comparison with TCs

Two days were selected early in the irradiation process to closely compare the calculated results with the TC readings. January 08, 2007, was chosen as the first day because the reactor was at full power and the gas flow was 100% helium. March 09, 2007, was chosen as the second day because this was the first full day of running with steady power and a mixture of helium and neon. Thermocouples had not become decalibrated by this time. Neck shims were not pulled and the OSCCs were not rotated during the day. The average temperature difference on Jan 08, 2007, was -22°C, and on March 09, 2007, -22°C. Figure 20 shows the final run to calibrate the model in order to minimize the difference between the measured TCs and the calculated TC temperatures. The only variable that could change was the emissivity of the stainless-steel retainer. It stayed at 1.0, just as in Revision 0 of this document. Conductivity of the graphite varying with fluence was used in these calculations. Even though the predictions were above the TC measurements, this was as close as could be predicted with these models with no other variables being changed.

		Capsule 6					Capsule 5					Capsule 4				
		Avg TC_1	Avg TC_2	Avg TC_3	Avg TC_4	Avg TC_5	Avg TC_1	Avg TC_2	Avg TC_3	Avg TC_4	Avg TC_5	Avg TC_1	Avg TC_2	Avg TC_3	Avg TC_4	Avg TC_5
Mar 09, 2007 NDMAS DATA	**139 A**	892	726	696	697	721	841	failed	781	.	.	843	1064	792	.	.
ABQ Results ==> (°C)		987	850	817	817	838	792		661			824	1118	815		
TC - ABAQUS		-95	-124	-121	-120	-117	49		120			19	-54	-23		
Average(TC - ABAQUS)		**-22**		14												
RMS (TC - ABAQUS)		320					ε ss = 1.0, VF = 1.0, Fluence=variable, Rad End to 400, Heat Mult Factor=1.00									
Jan 08, 2007 NDMAS DATA	**138B**	.	.	429	.	.	.	.	457	.	.	.	.	396	.	.
ABQ Results ==> (°C)		637	557	532	532	548	495		450			456	615	446		
TC - ABAQUS				-103					7					-50		
Average(TC - ABAQUS)		**-22**														
RMS (TC - ABAQUS)		120					ε ss = 1.0, VF = 1.0, Fluence=variable, Rad End to 400, Heat Mult Factor=1.00									

Capsule 3					Capsule 2					Capsule 1				
Avg TC_1	Avg TC_2	Avg TC_3	Avg TC_4	Avg TC_5	Avg TC_1	Avg TC_2	Avg TC_3	Avg TC_4	Avg TC_5	Avg TC_1	Avg TC_2	Avg TC_3	Avg TC_4	Avg TC_5
861	749	837	.	.	609	835	844	.	.	705	877	.	.	.
	don't use				failed don't use					failed don't use				
796	846	803			761	820	765			927	928			
65	-97	34			-152	15	79			-222	-51			
.	.	469	.	.	.	.	472	.	.	.	508	.	.	
444		448				472	457				532			
		21					15				-24			

Figure 20. Final runs performed to calibrate model to minimize difference with TCs on January 08, 2007, and March 09, 2007.

Gas Gaps Changing Linearly with Time

The control gas gaps and the compact-graphite holder gas gaps were modeled as changing linearly with time. This was accomplished by having the gap conductivity of each capsule change with fluence. Fluence was set at Field Variable 2 in the ABAQUS model. Capsules

2 and 5 had a third field variable, the axial location of the control gas gap, that was not used. The control gas gap was divided into six heights. This capability would allow six different gas gaps along the height of the capsule. The original finite element mesh models created in ABAQUS were done with the as-built dimensions for the gas gaps. PIE measurements shown in Reference [4] were used as the final gas gaps. The gas gaps were assumed to be the hot gas gap dimension—the hot gas gap dimension and room temperature gas gap dimension being virtually the same. Appendix C shows the conductivity values used for each gas gap for each capsule. Table 2 shows the starting and ending gas gap dimensions for the control gas gap and the compact-graphite holder gas gap. The graphite holder might be experiencing irradiation swelling, causing the compact-holder gap to increase and the control gap to decrease. The gas mixture conductivity for the control gas gap was ratioed by the original model gap compared to the time varying gap. This was also done for the gap between the compacts and holder that use the gap conductance model in ABAQUS.

Table 2. Gas gap dimensions varying by capsule and time.

Capsule #	Control Gap Start (in)	Control Gap End (in)	Compact – Holder Gap Start (in)	Compact – Holder Gap End (in)	Ending Fluence ($x10^{25}$) (n/m^2)
6	0.0282	0.0308	0.0025	0.0066	2.56
5	0.0141	0.0061	0.0025	0.0066	3.37
4	0.0100	0.0050	0.0025	0.0065	3.78
3	0.0093	0.0047	0.0025	0.0065	3.82
2	0.0110	0.0040	0.0025	0.0062	3.54
1	0.0180	0.0217	0.0025	0.0035	2.86

DISCUSSION/ANALYSIS

Figures 21 through 48 show the results of the daily as-run calculated heat transfer analyses. Typical temperature contour plots of various components and fuel compacts are discussed first, followed by historical plots of daily temperatures, TC predictions, comparisons with experimental TCs, and volume average time averaged temperatures.

Temperature Results

Temperature contour plots of the various components begin on the outer portion of the model and work towards the center where the fuel compacts are located. These plots are for Capsule 4 during day 29 of Cycle 141A, as this appears to be an average day during the experiment. Figure 21 shows a cutaway view of the beryllium. An adiabatic boundary condition was placed on the top, bottom, and outside of this component. Heat generated in the beryllium is transported directly to the water. Water flows from left to right in the figure. A temperature contour plot of the water channel is shown in Figure 22. A temperature boundary condition on the inlet of 132°F (56°C) was implemented. The typical temperature rise through each experiment is about 4 to 5°F (2 to 3°C).

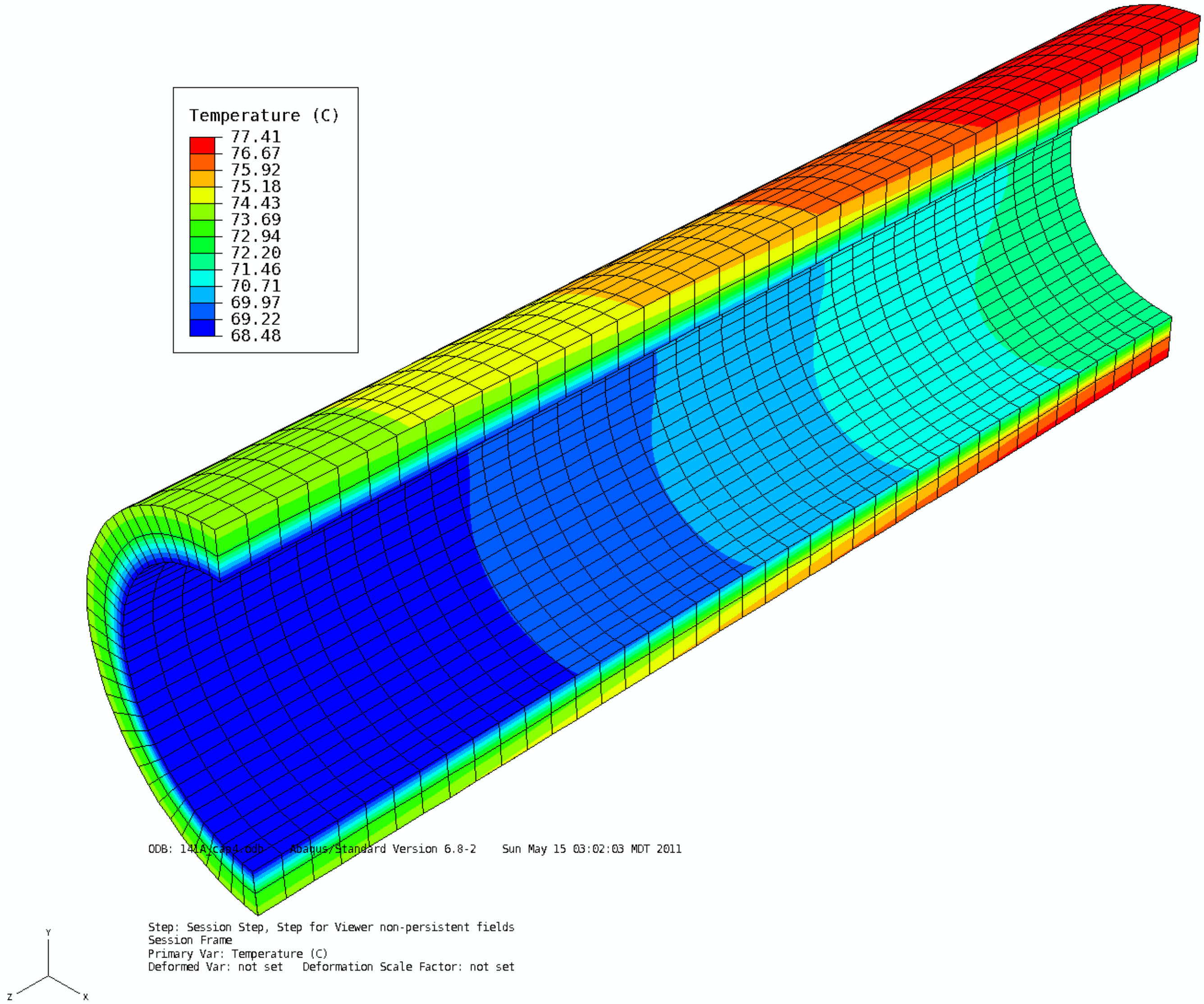


Figure 21. Temperature (°C) contour plot of cutaway view of beryllium.

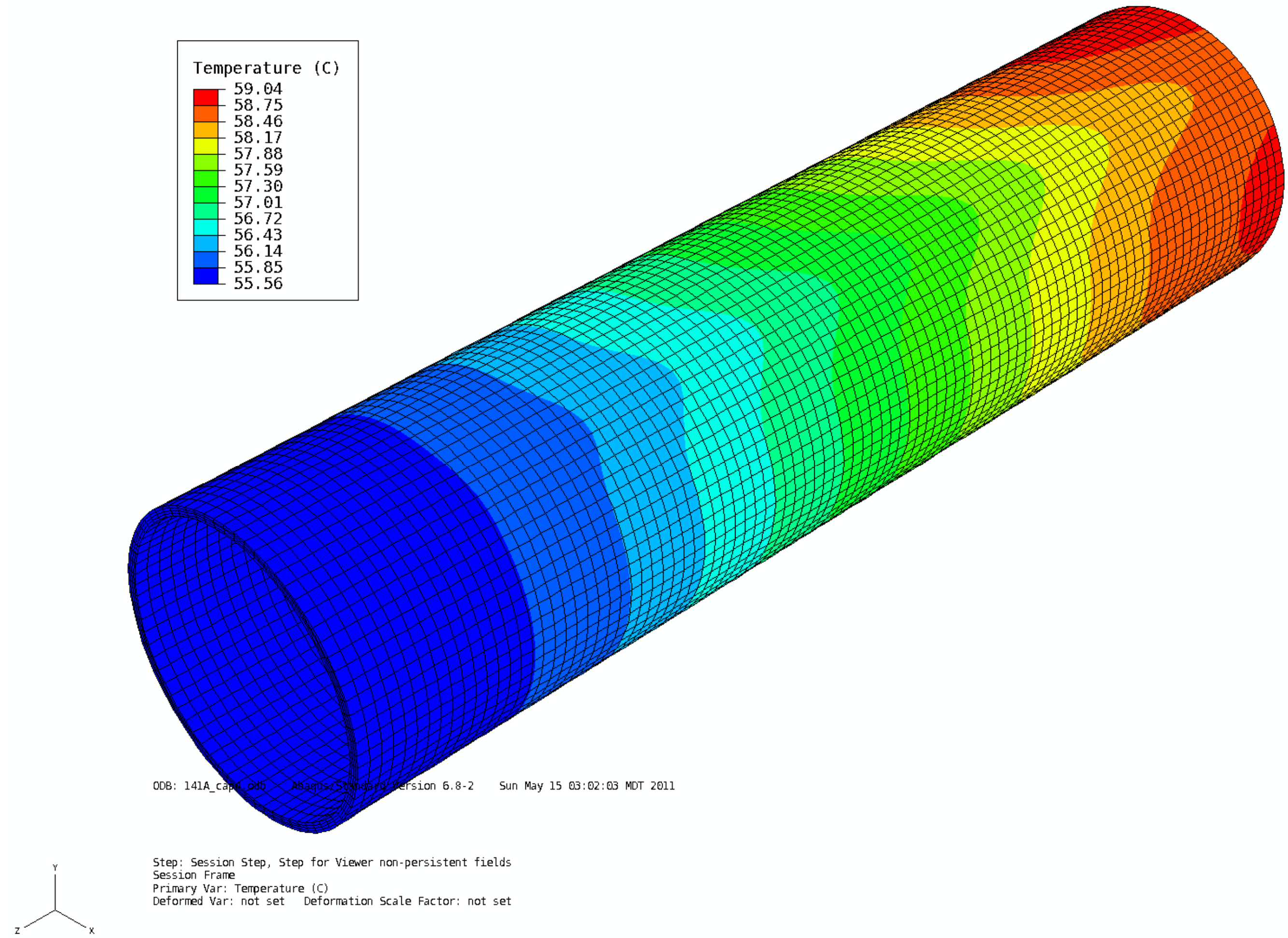


Figure 22. Temperature (°C) contour plot of water channel.

Figure 23 shows a cutaway view of the temperature contours of the stainless-steel pressure boundary. The inner surface shows that the majority of heat (red portion) comes from the outer surface of the graphite holder area, while the green portion comes from the thru tubes region. The maximum temperature is 132°C. Figure 24 shows the entire hafnium neutron absorber, while Figure 25 shows the stainless-steel filler.

A temperature contour plot of the stainless-steel retainer is shown in Figure 26. Again, the most heat transfer occurs across the gap with the graphite holder, while less occurs across the gap from the thru tubes. This stainless-steel retainer is part of the same mesh as the graphite holder and gas gaps for the center portion. Notice that the mesh changes near the top and bottom. These small mesh areas were added later in the modeling to allow heat transfer from the graphite spacers and rings on the top and bottom of the model. A *Tie Constraint was used in the ABAQUS model to intimately connect the different meshes. Unfortunately, the thru tubes were not extended into these upper and lower regions so no radiation heat was transferred from the thru tubes to the stainless-steel retainer. The graphite spacers at the top and bottom radiate and conduct the heat to the stainless-steel retainer. This accounts for the dark blue region in the top and bottom areas of the attached mesh.

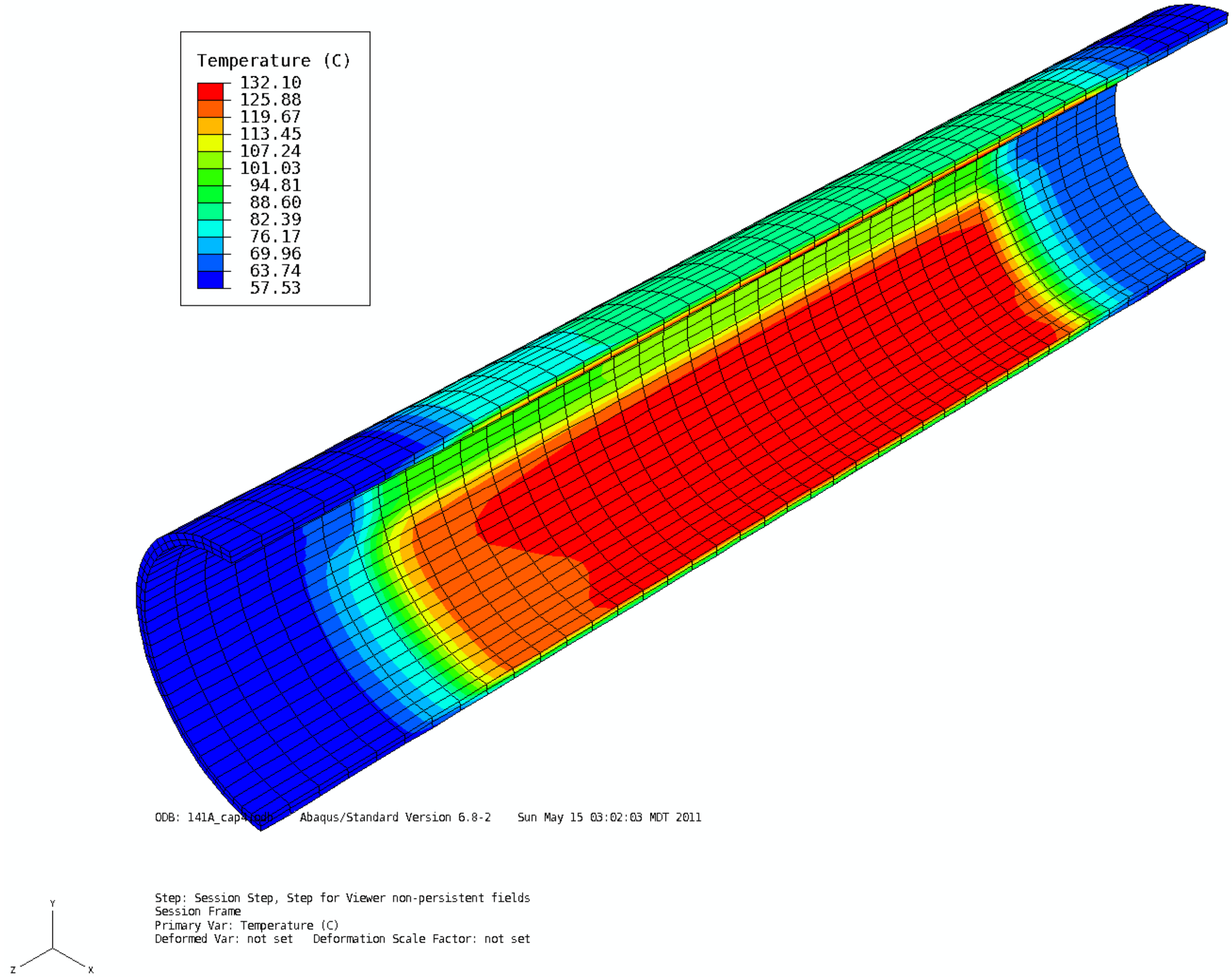


Figure 23. Temperature (°C) contour plot of cutaway view of pressure boundary.

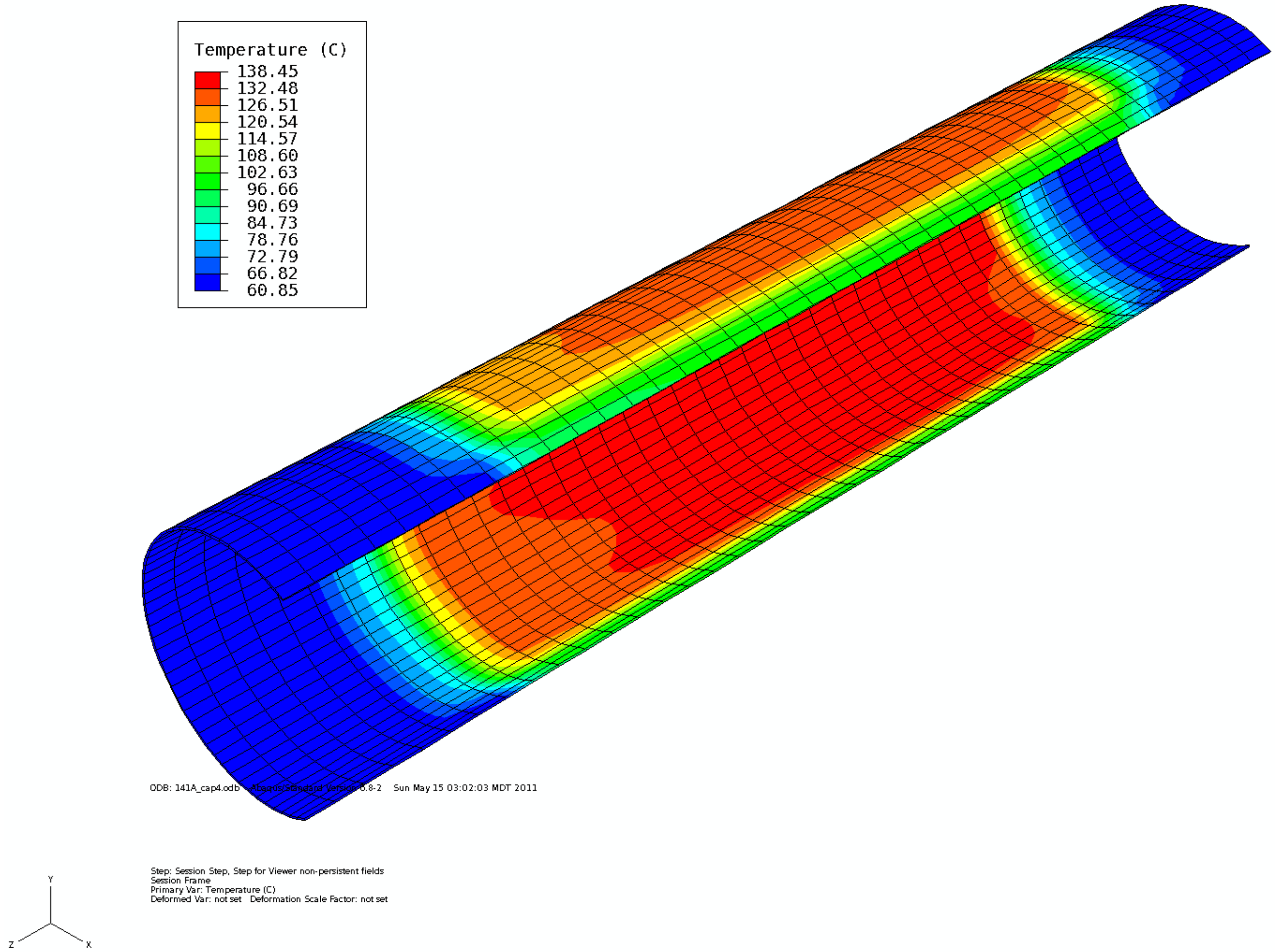


Figure 24. Temperature (°C) contour plot of hafnium.

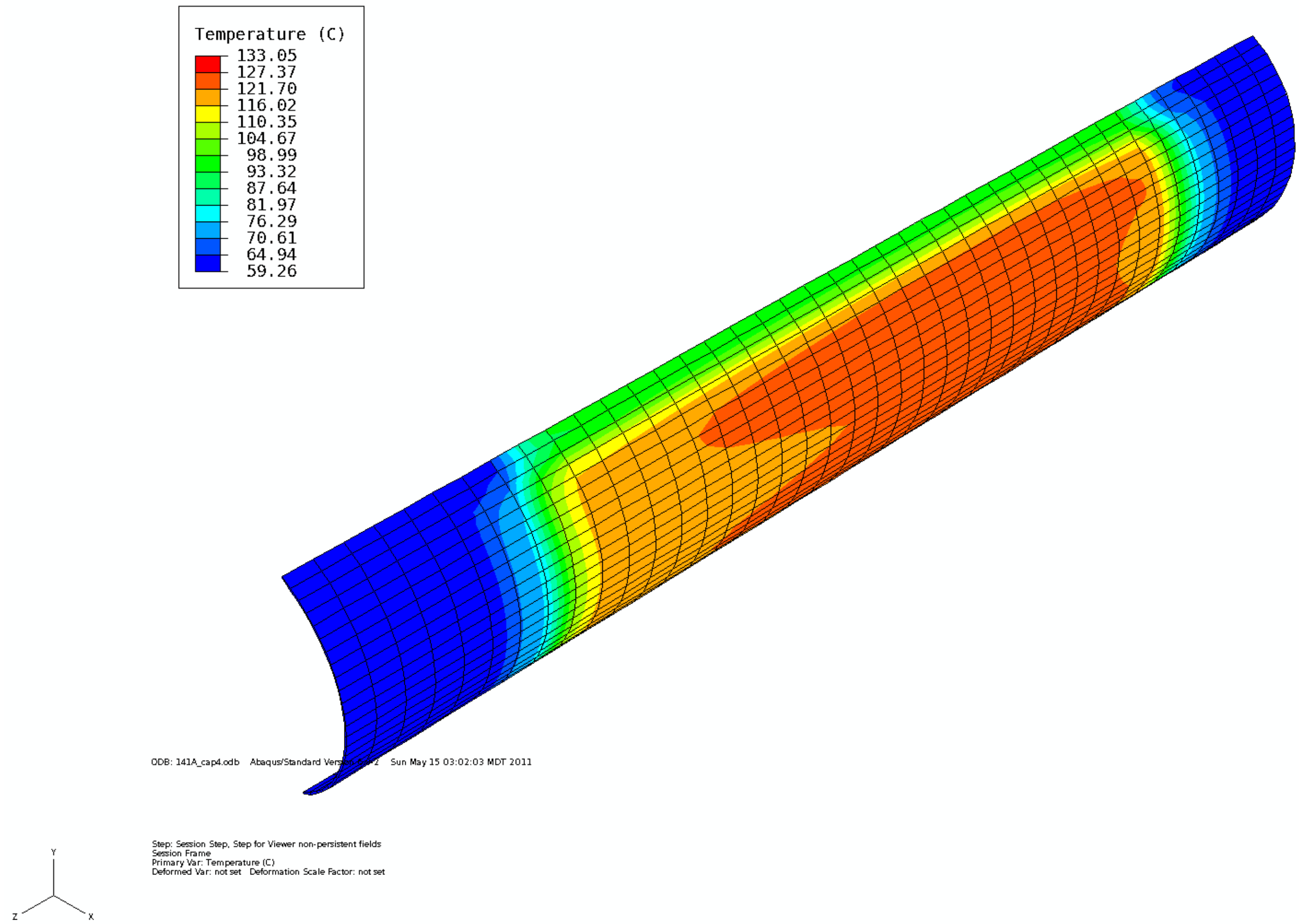


Figure 25. Temperature (°C) contour plot of stainless steel filler.

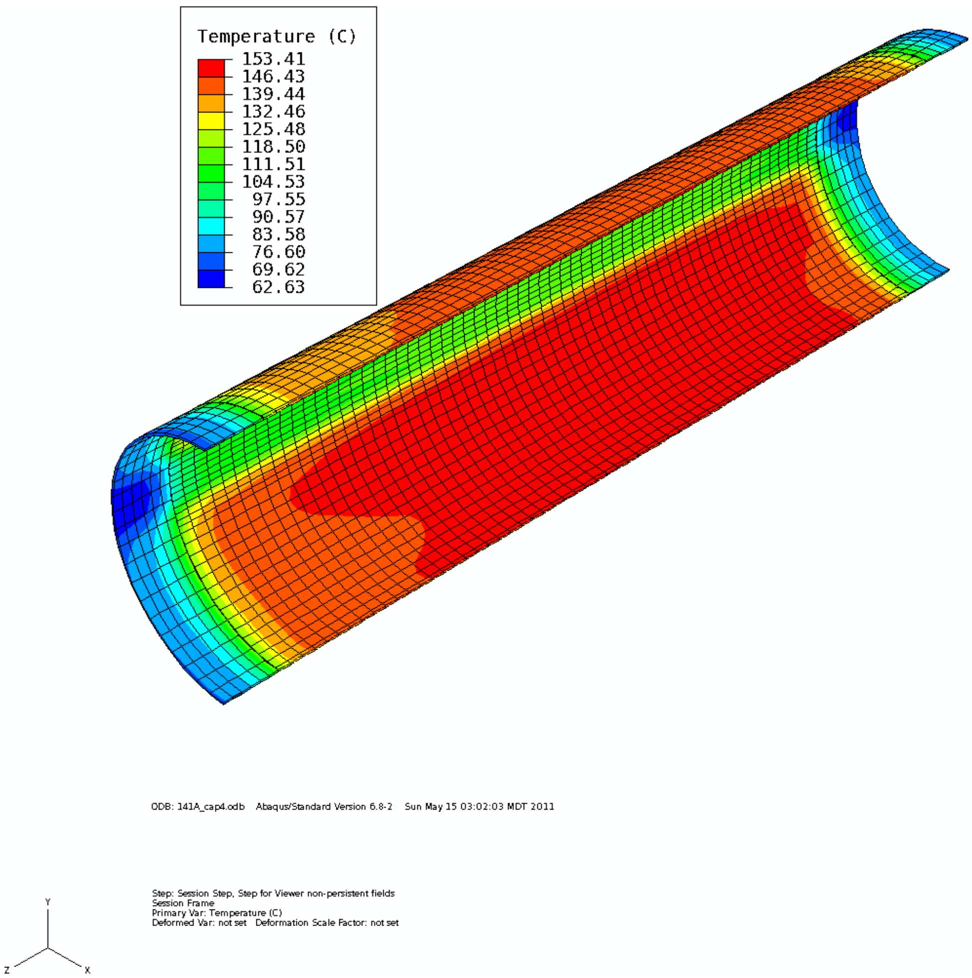


Figure 26. Temperature (°C) contour plot of stainless steel retainer.

Figure 27 shows a cutaway view of the temperature contour plot of the gas. The hottest portion of the gas is between the thru tube and the graphite holder. This occurs because it is nearest to the fuel compacts. This small gap between the graphite holder and the stainless-steel retainer was machined differently for each capsule to give even temperatures for all capsules, meaning that the top and bottom capsules have bigger gas gaps, while the ones near the core midplane are smaller.

The thru tubes are shown in temperature contour plots in Figure 28. Hottest temperatures occur near the axial center of each capsule, while the coolest portions are near the top and bottom away from the experiment centerline. Figure 29 shows a temperature contour plot of the entire graphite holder. All of the heat generated in the fuel compacts is conducted through this entity. Radiation heat transfer occurs from the outer surfaces of the graphite holder to the stainless-steel retainer. The emissivity of the graphite and the stainless steel was assumed to be 1.0 and 0.99 in order to match TC data. A view factor of 1.0 was also assumed for the radiation across this small gas gap. Temperature dependent and fluence dependent thermal conductivity was modeled for the graphite components in the AGR-1 experiment. Neutron damage has less of an effect on the thermal conductivity at higher temperatures when the reactor is running at full power compared to lower temperatures during startup and 100% helium flow. Figure 30 shows a cutaway view of the temperature contour plot of the graphite holder. The hottest region occurs in the very center of the holder.

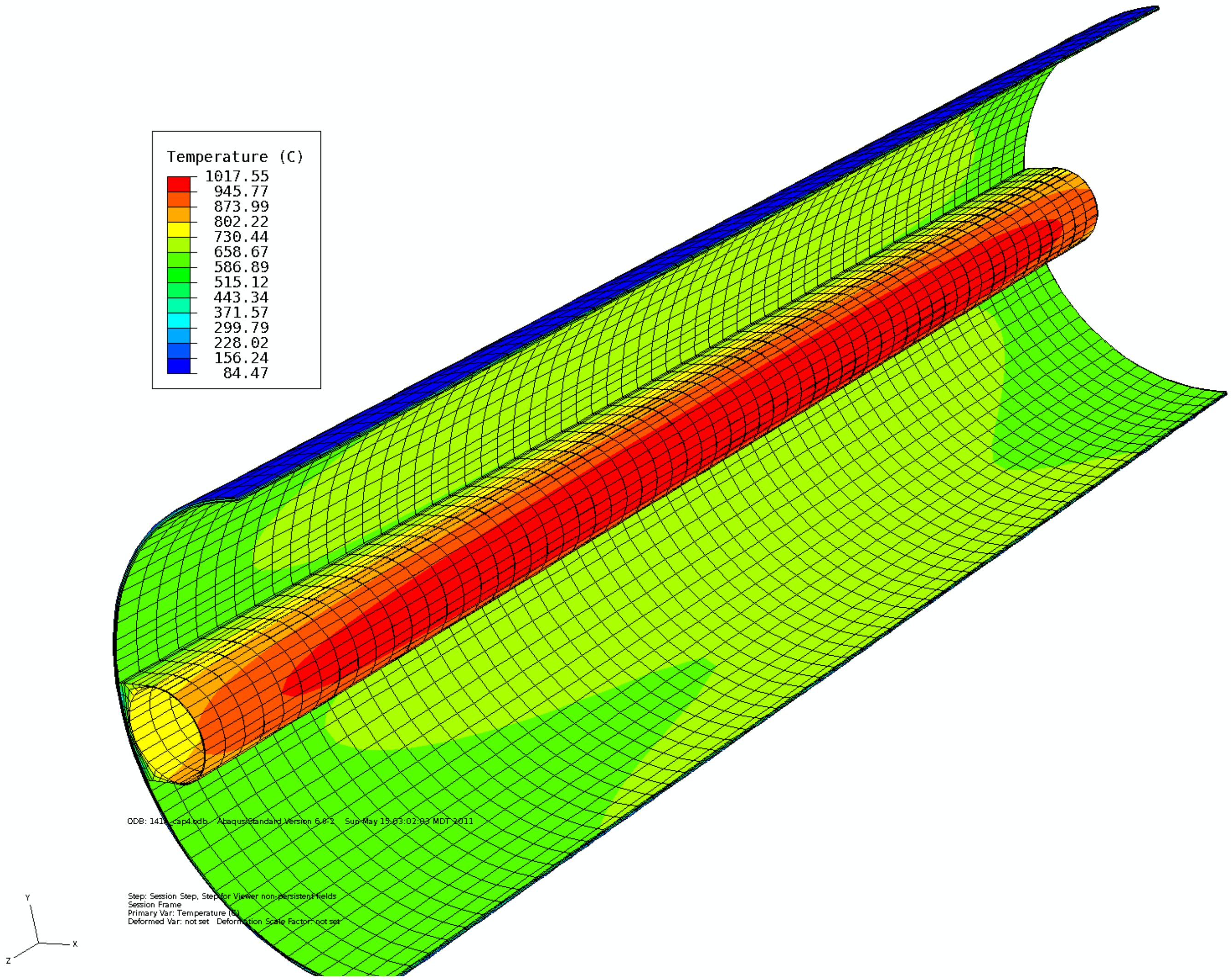


Figure 27. Temperature (°C) contour plot of cutaway view of gas surrounding graphite holder and thru tube.

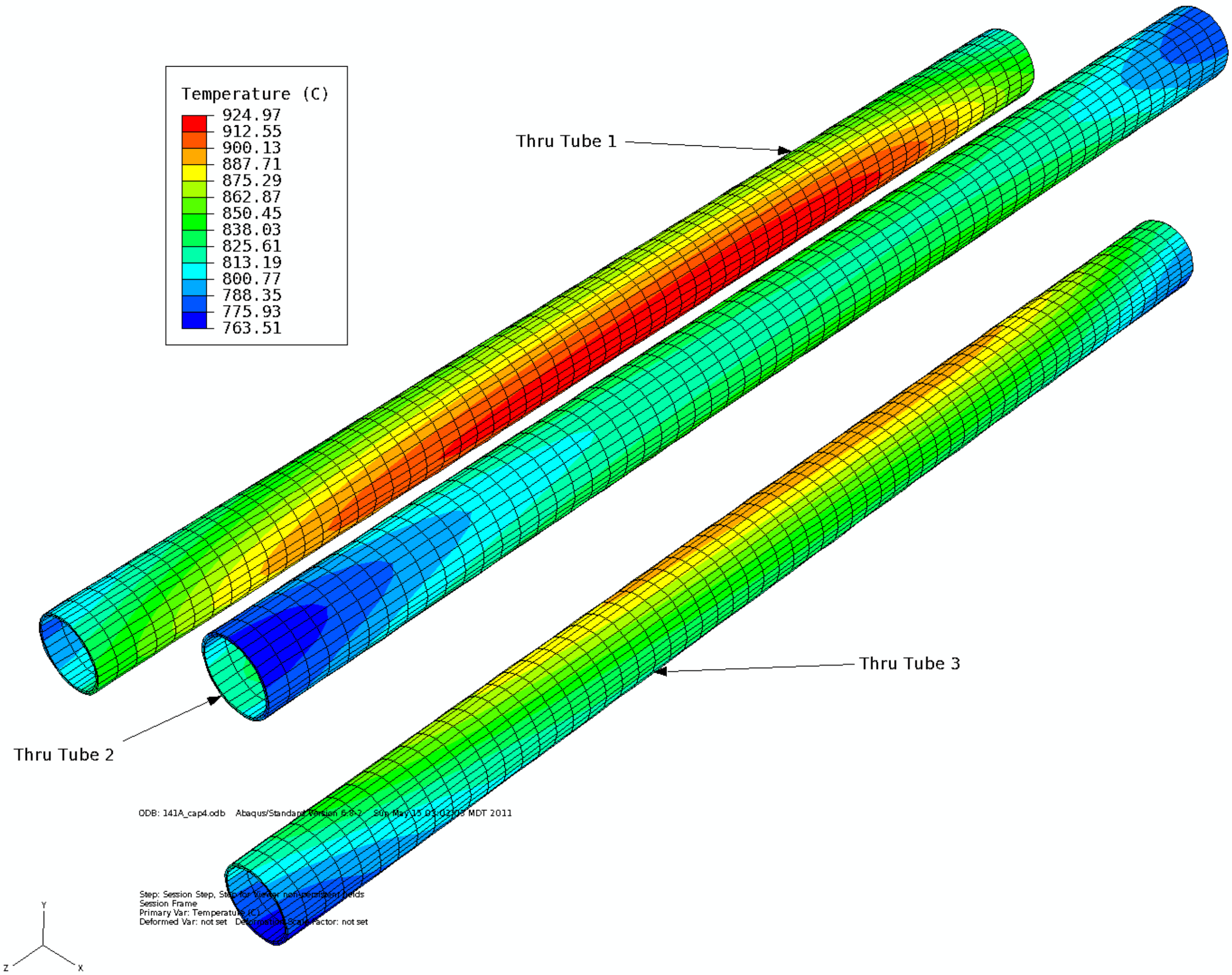


Figure 28. Temperature (°C) contour plot of thru tubes.

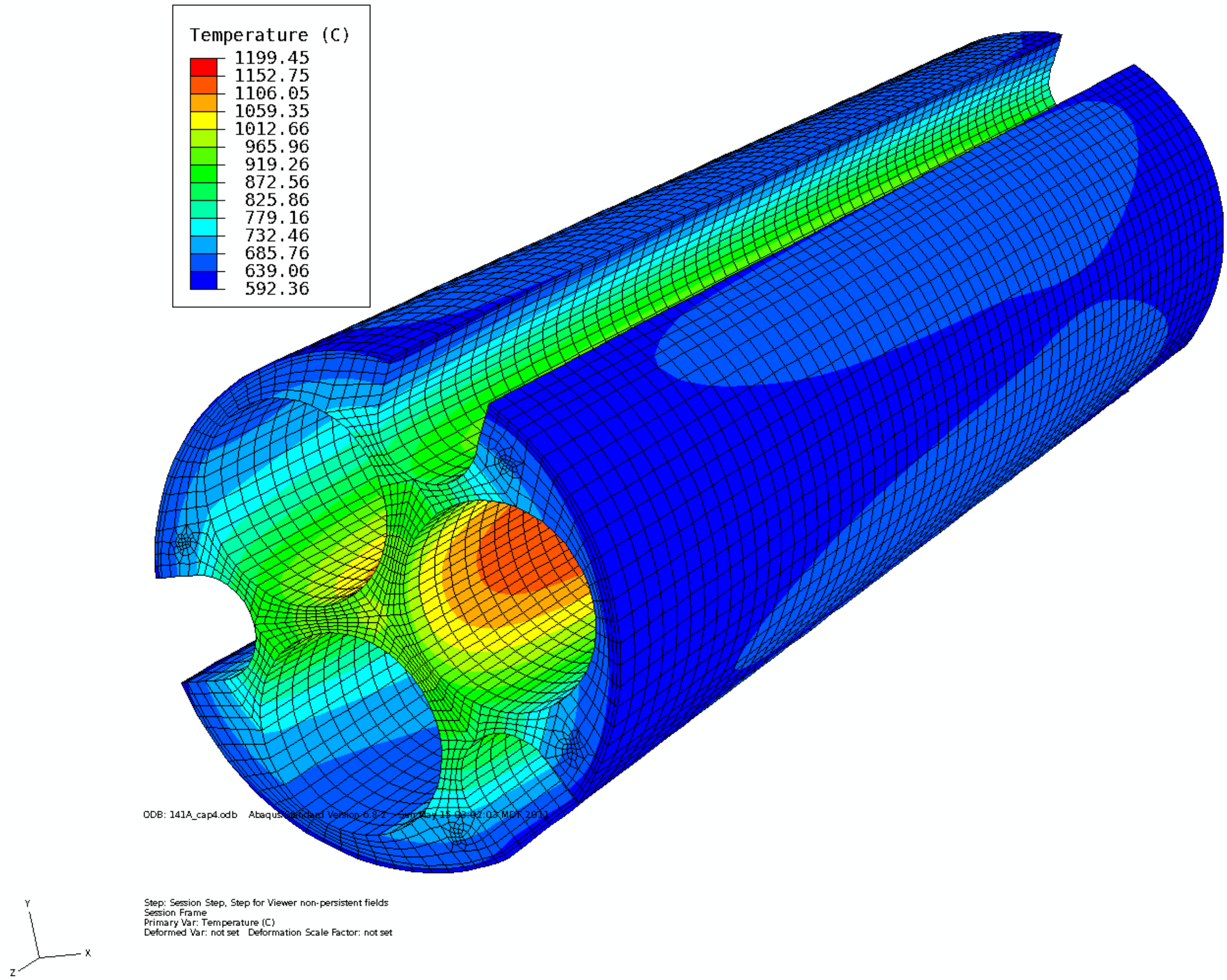


Figure 29. Temperature (°C) contour plot of graphite holder.

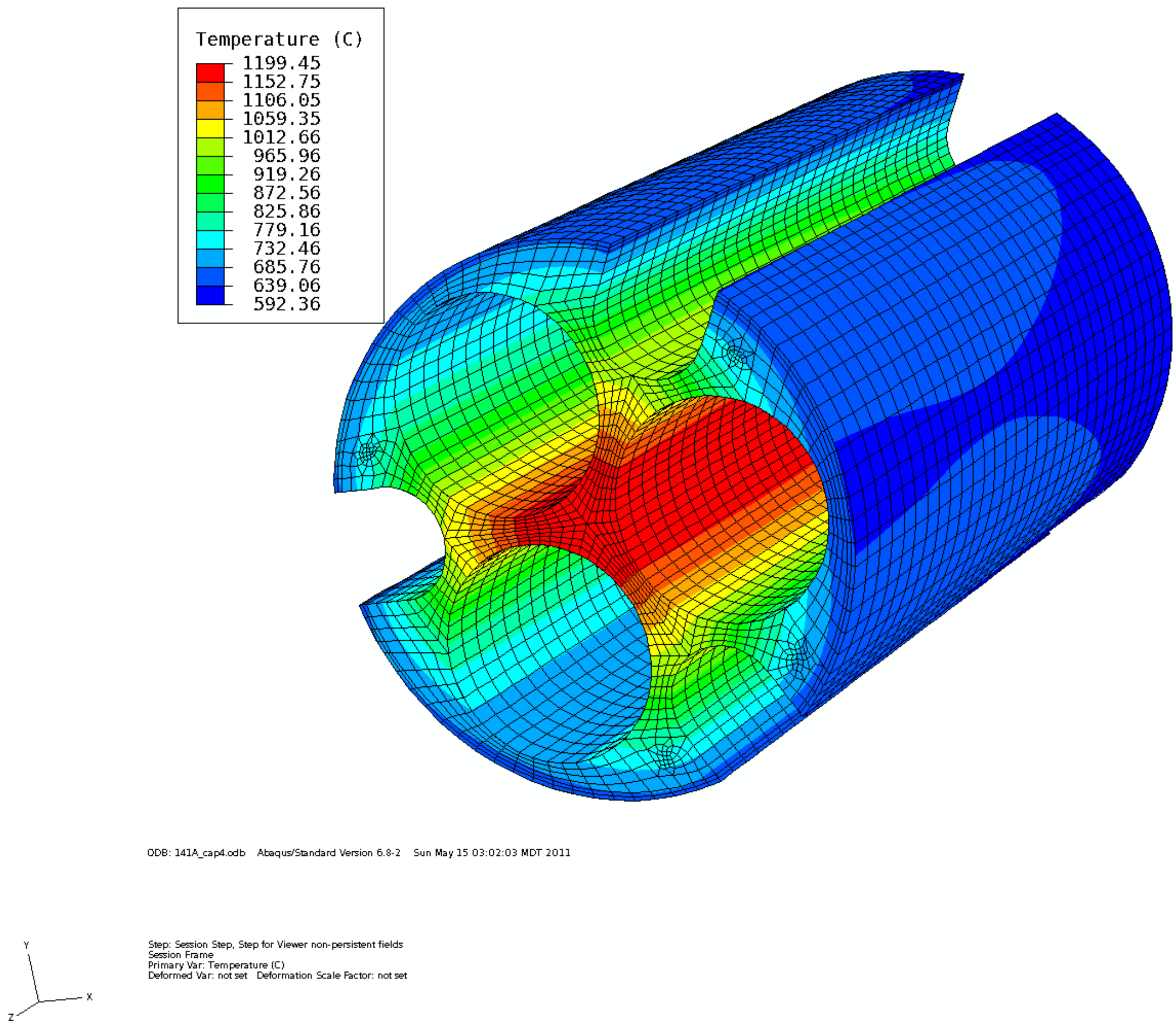


Figure 30. Temperature (°C) contour plot of cutaway view of graphite holder.

Figure 31 shows a cutaway view of the three fuel compact stacks. Temperatures range from 802°C to a maximum of 1256°C. Stacks 1 and 3 have higher temperatures than Stack 2 because they are closer to the core center. Figures 32, 33, and 34 show the temperature contours of Stacks 1, 2, and 3, respectively. Each figure is slightly rotated so that the hottest region can be clearly seen. Figure 35 shows a temperature contour plot of the bottom 0.15-in. of the graphite holder along with the graphite spacer, graphite ring, and another graphite spacer. A *Tie Constraint option is used in the ABAQUS input model that intimately links these components together from a heat transfer standpoint. Gap conductance and radiation occurs between the two spacers and the outer surfaces to the stainless-steel retainer. The radial gap between these bottom three parts and the stainless-steel retainer is 0.038 in. In ABAQUS, a *Surface Radiation boundary condition was placed on the bottom surface of the bottom graphite spacer radiating to 400°F (204.4°C). This value was determined after looking at previous models from Ambrosek in

Reference [1]. The complete model in Reference [1] has a grafoil material next to the bottom graphite spacer, then a very large gas gap, followed by the stainless steel end cap.

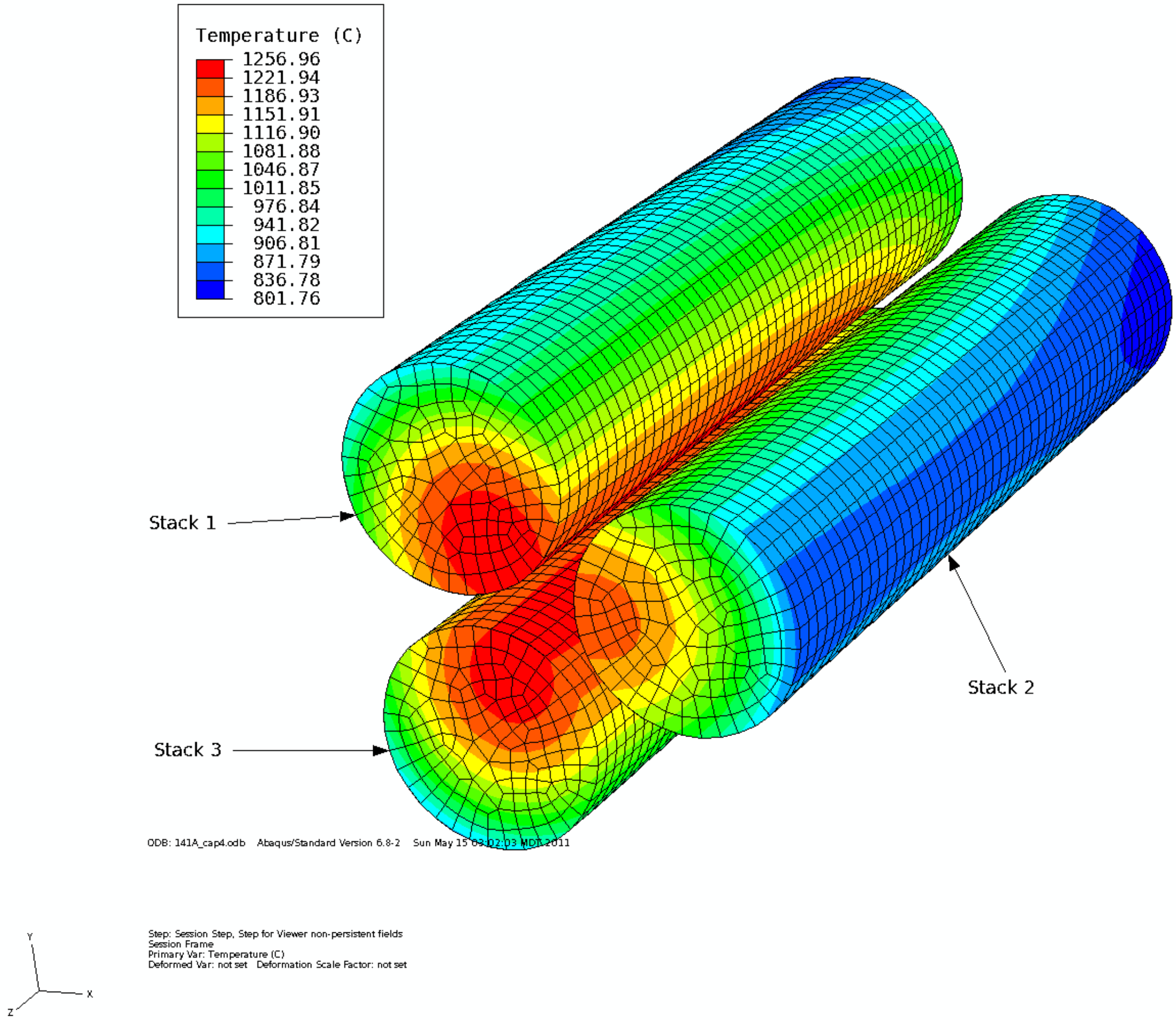


Figure 31. Temperature (°C) contour plot of cutaway view of three fuel stacks.

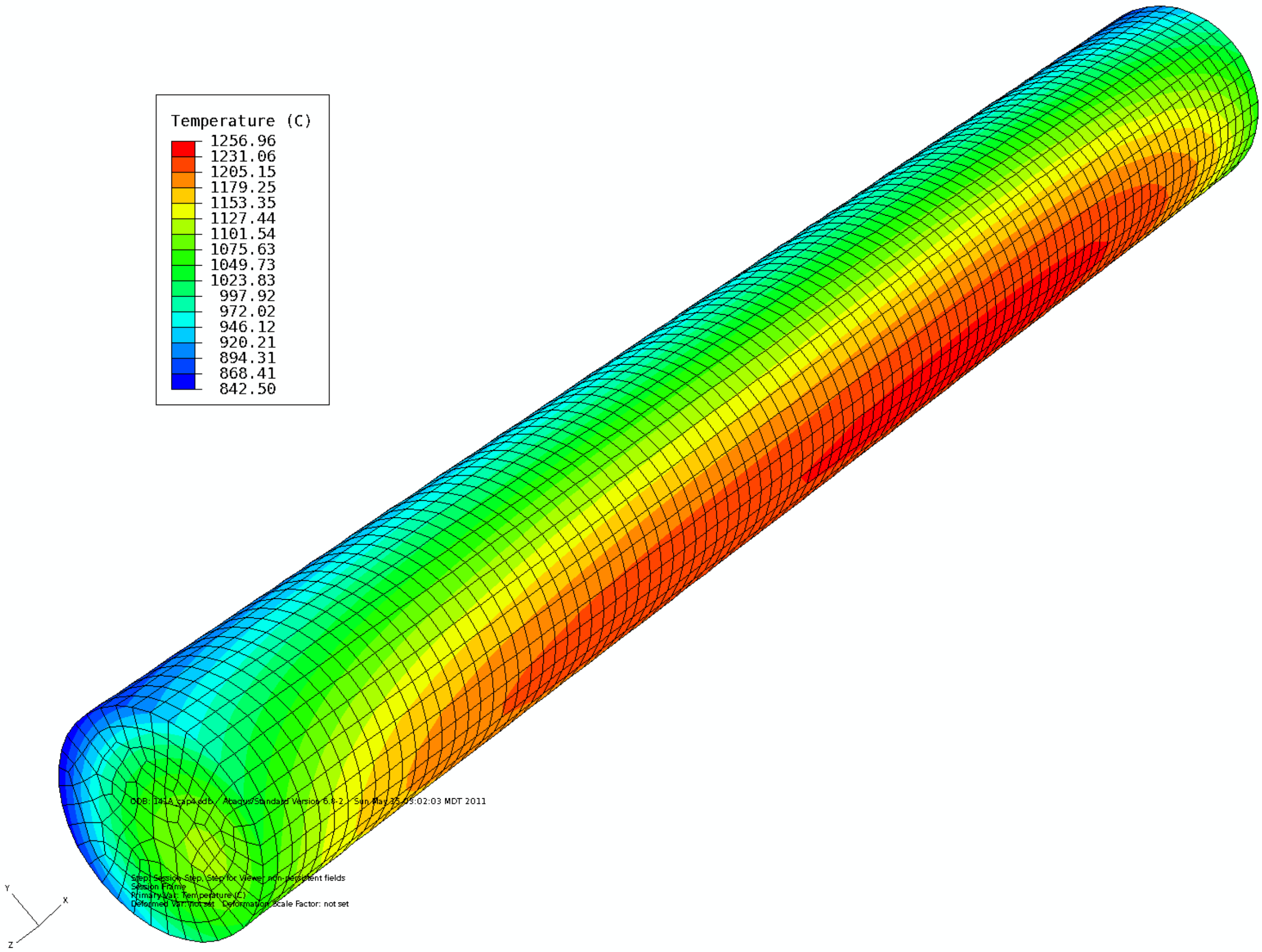


Figure 32. Temperature (°C) contour plot of Stack 1.

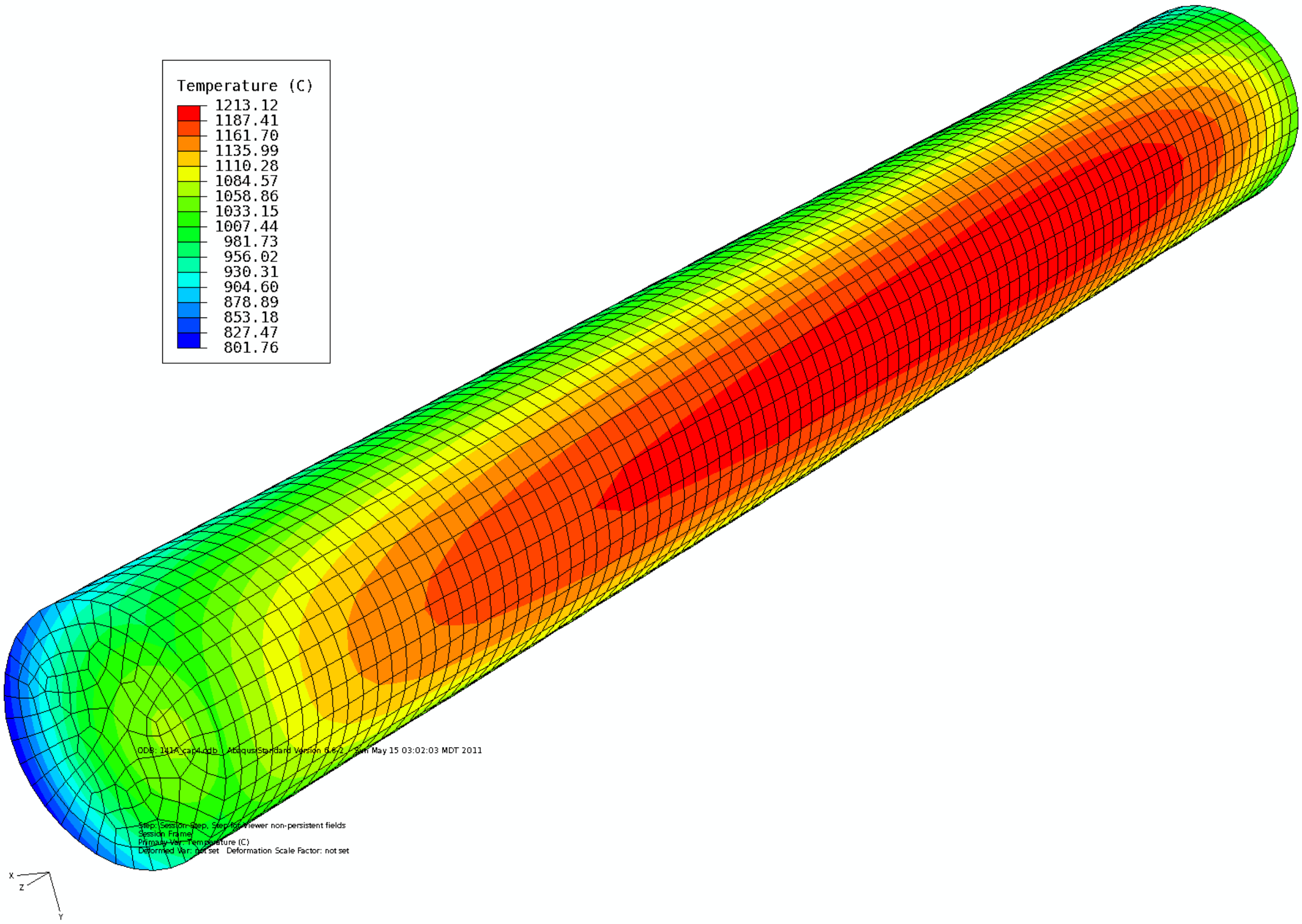


Figure 33. Temperature (°C) contour plot of Stack 2.

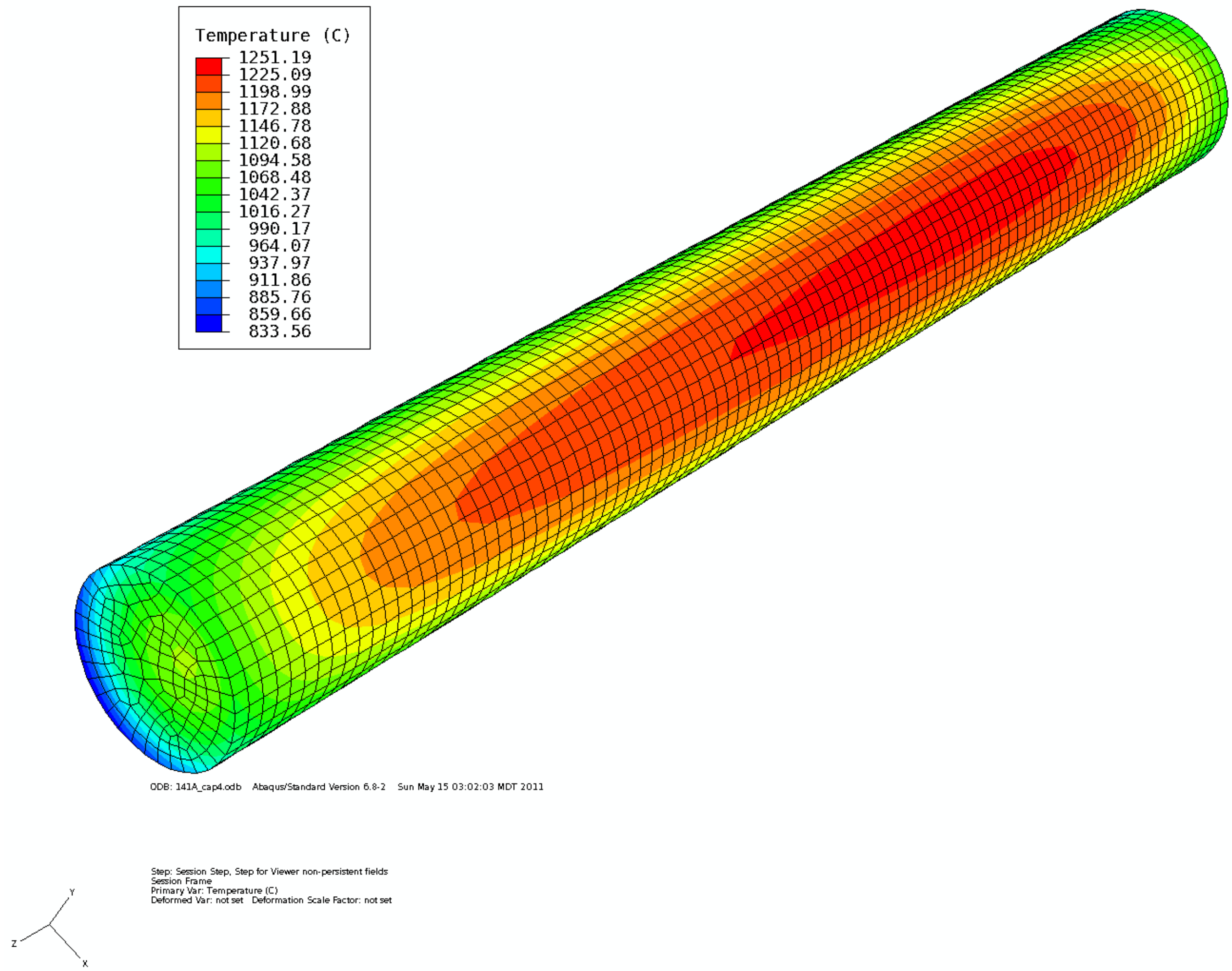


Figure 34. Temperature (°C) contour plot of Stack 3.

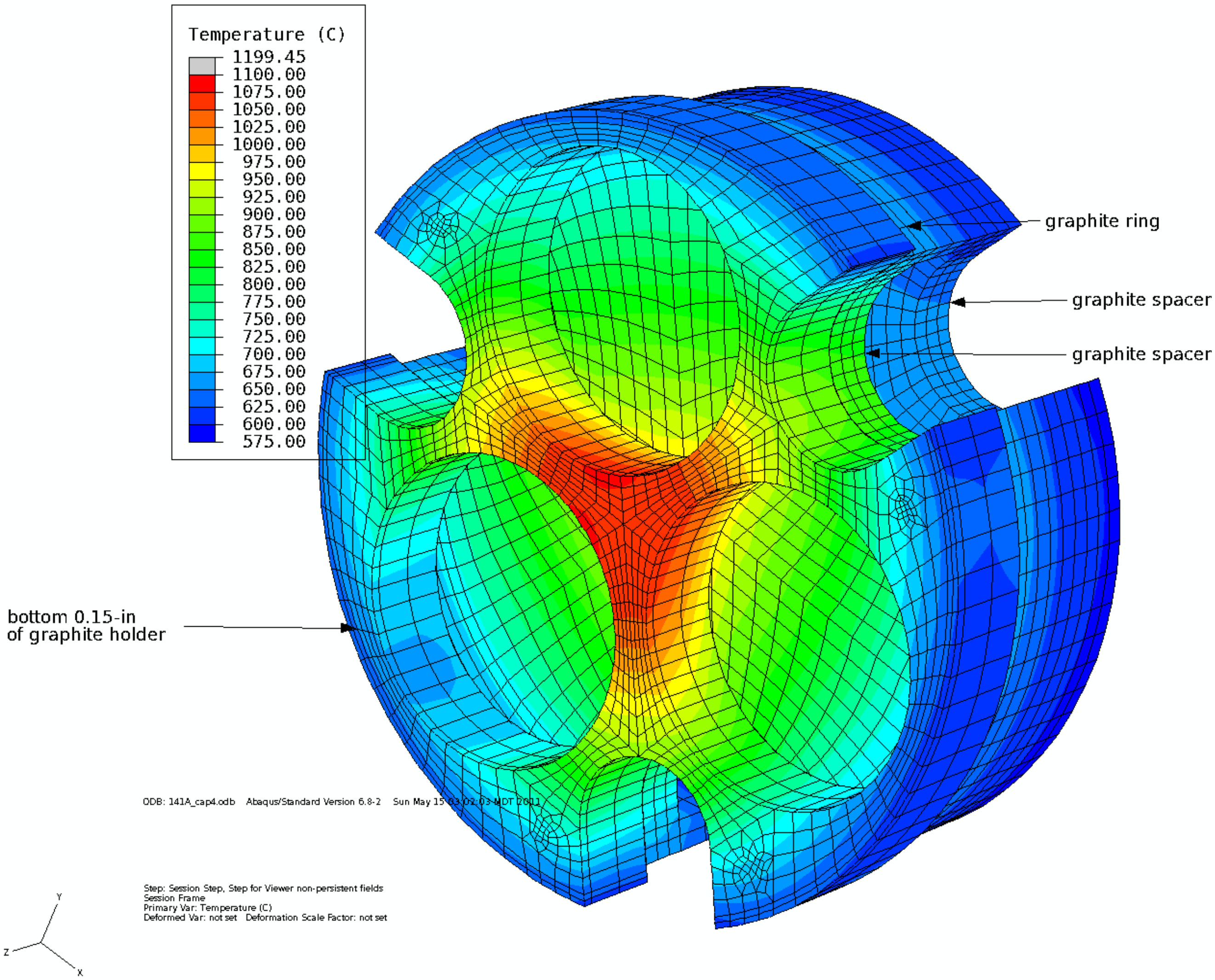


Figure 35. Temperature (°C) contour plot of bottom 0.15-in. of graphite holder, bottom graphite spacers, and bottom graphite ring.

Figure 36 shows a temperature contour plot of the graphite spacer next to the bottom of the graphite holder, while Figure 37 shows a temperature contour plot of the graphite ring next to the spacer. Figure 38 shows a temperature contour plot of the bottom graphite spacer. All of these graphite components are near the same temperature as the end of the graphite holder. Capsules 1 and 6 have 5.5% boron in the graphite, while Capsules 2–5 have 7.0% boron, which is slightly less conductive.

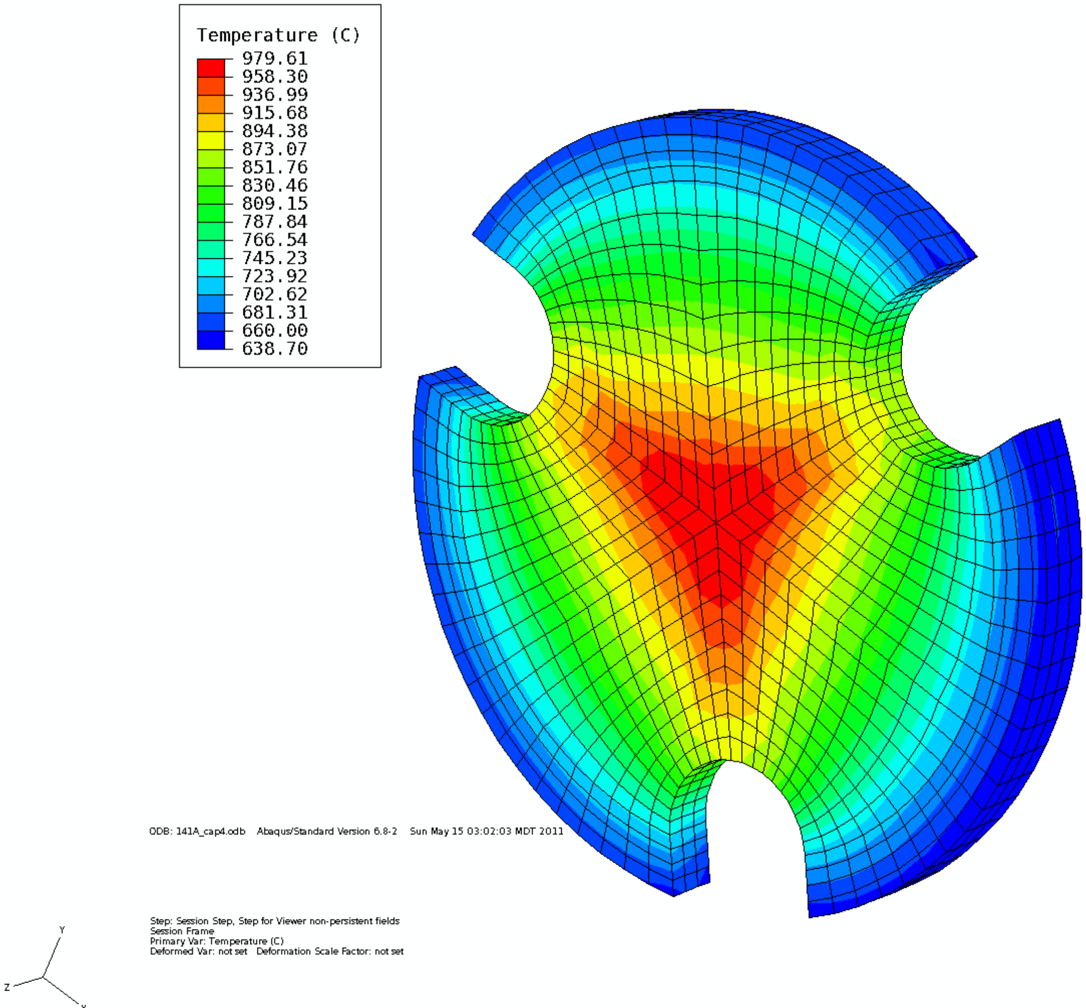


Figure 36. Temperature (°C) contour plot of graphite spacer next to bottom of graphite holder.

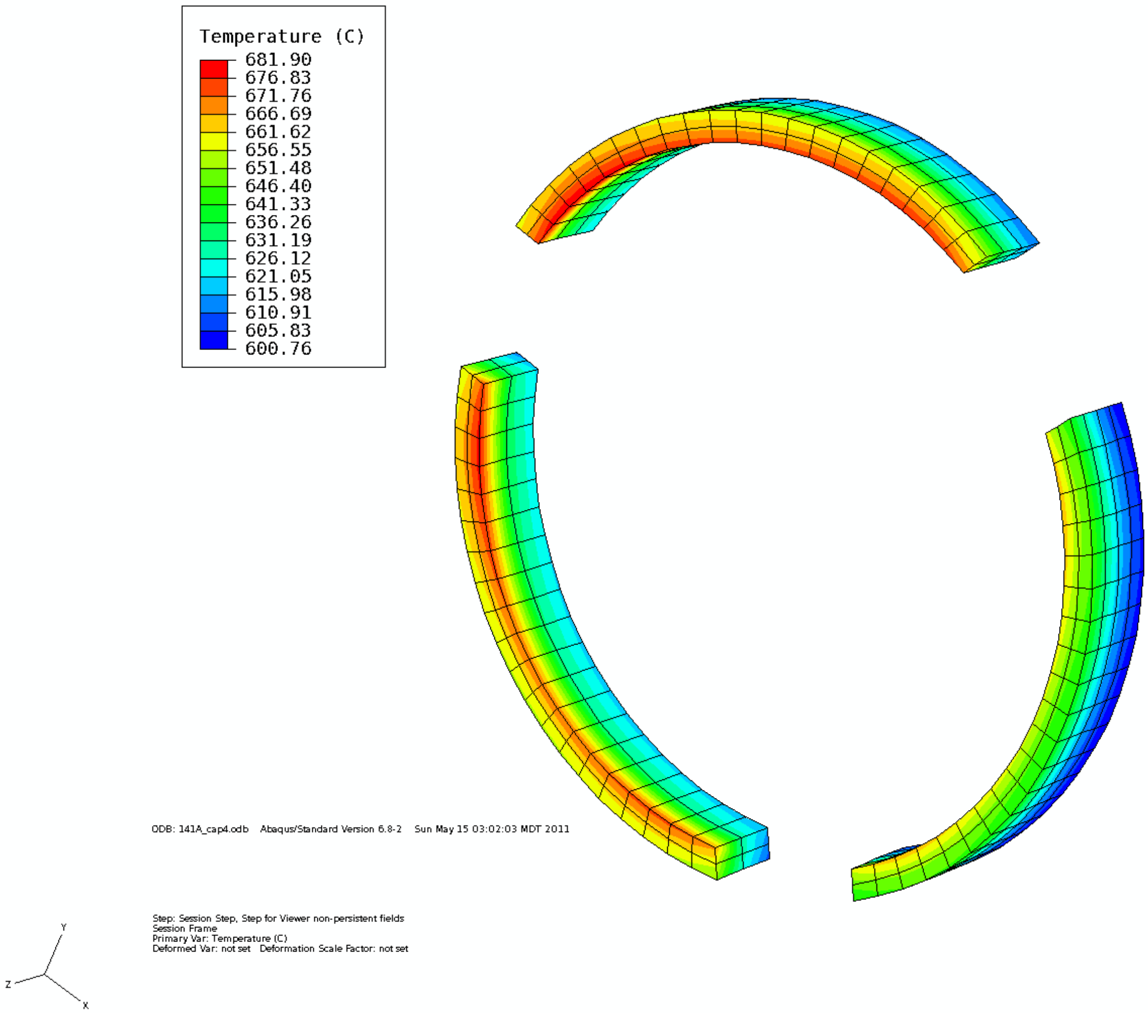


Figure 37. Temperature (°C) contour plot of bottom graphite ring.

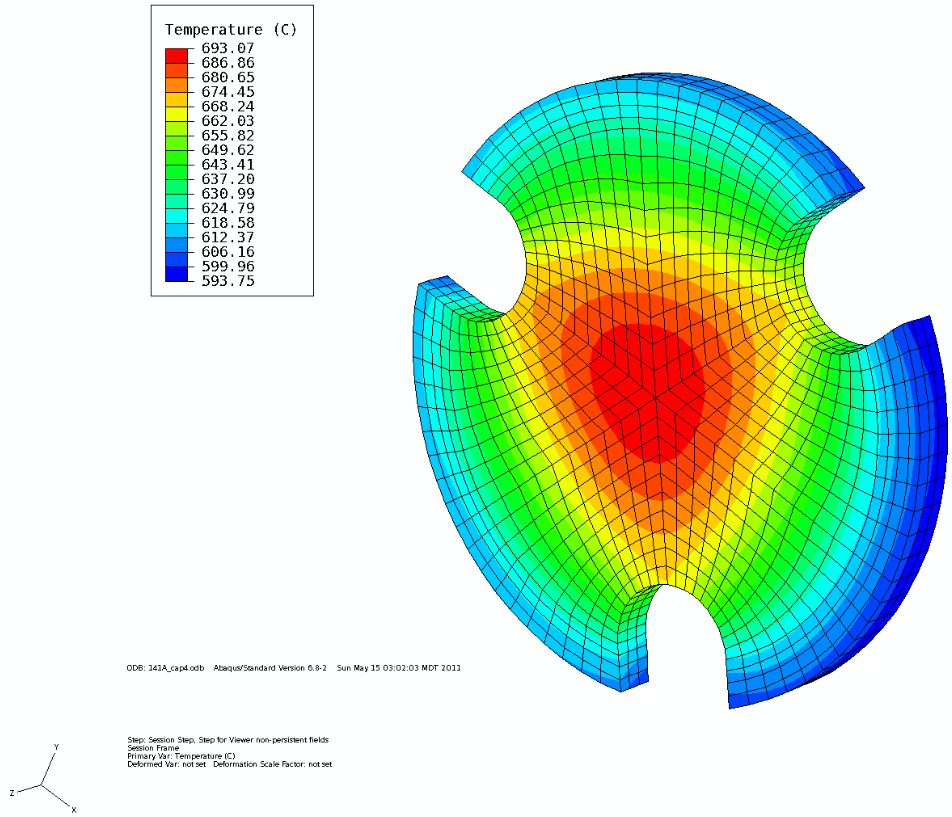


Figure 38. Temperature (°C) contour plot of bottom graphite spacer.

History Plots and Results

Figures 39 and 40 show the daily capsule average fuel maximum, average, and minimum temperature. Note that the maximum and minimum temperatures are point values, whereas the average is a volume average. The following equation was used to calculate the capsule average fuel temperatures:

$$T_{ave} = \frac{\sum T_i V_i}{\sum V_i} \quad (7)$$

where T_{ave} is the average capsule temperature, T_i is the finite element average temperature from each fuel compact finite element in ABAQUS, and V_i is the finite element volume from ABAQUS. A spike in temperature at the end of the third cycle (139B) was caused by the OSCC rotation without a change to more helium. The fifth and sixth cycle for Capsules 5 and 4 show lower temperatures because of a higher fraction of helium during these cycles.

Figure 41 shows the daily average TC temperature for each TC in each capsule. Capsules 3, 2, and 1 show the TCs failing about one-fourth of the way through the experiment. Capsule 6 shows that all five of its TCs lasted during the entire experiment. As predicted and measured, Capsule 5 has lower temperatures during the fifth and sixth cycles (140A and 140B). Figure 42 shows daily average TC measured and predicted temperatures. The

TC data is from the NDMAS database and is considered final as of the date of this document. Capsule 6, TC-1 shows that the calculated TC temperatures are above those measured by about 50°C. The difference between these two temperatures appears to be growing with time. The best correlation of all the measured and predicted TC temperatures is TC-3 for Capsule 5. A detailed discussion on TC performance is presented by Pope [11].

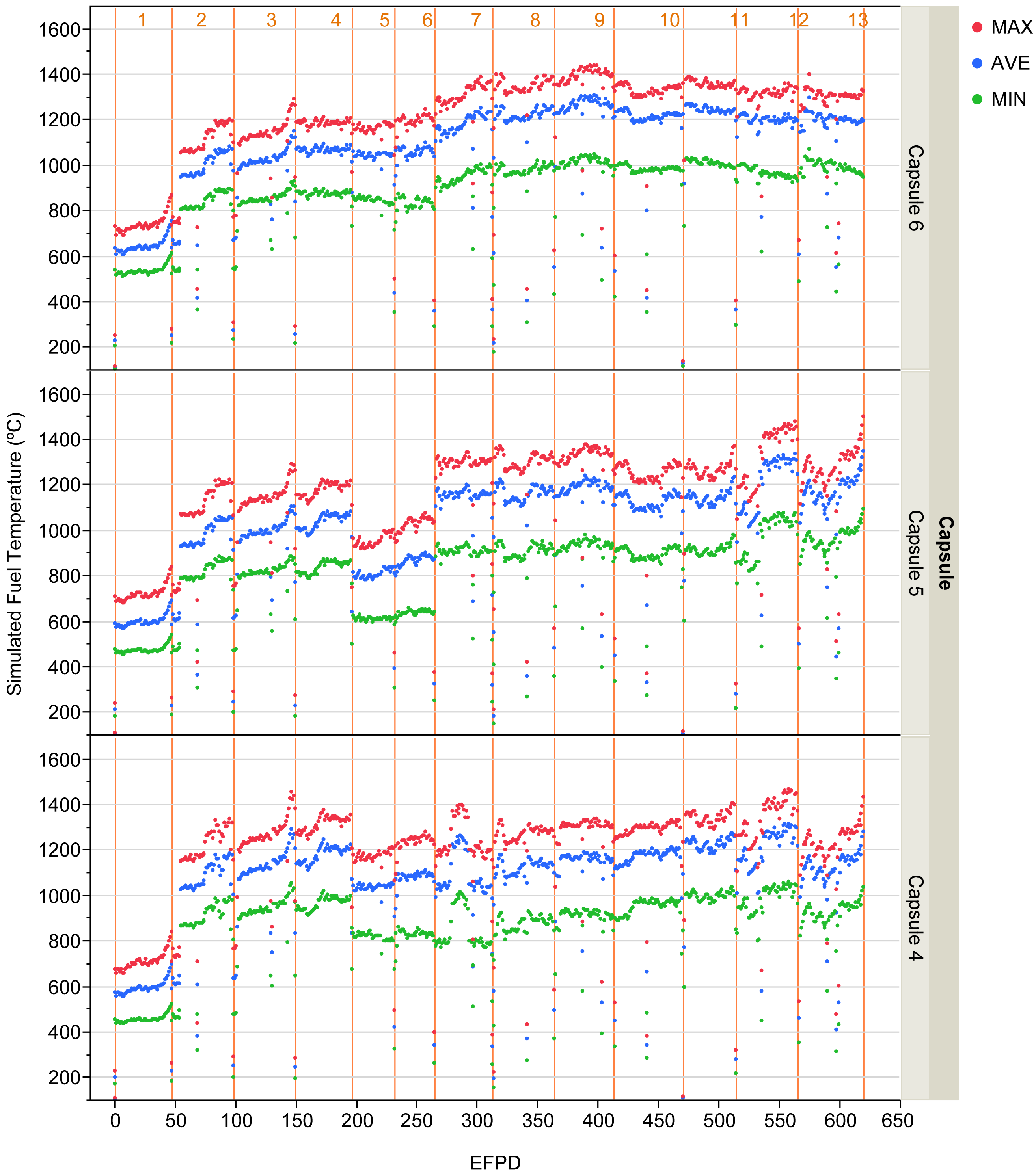


Figure 39. Temperature history of daily capsule minimum, maximum, and volume average for Capsules 4–6.

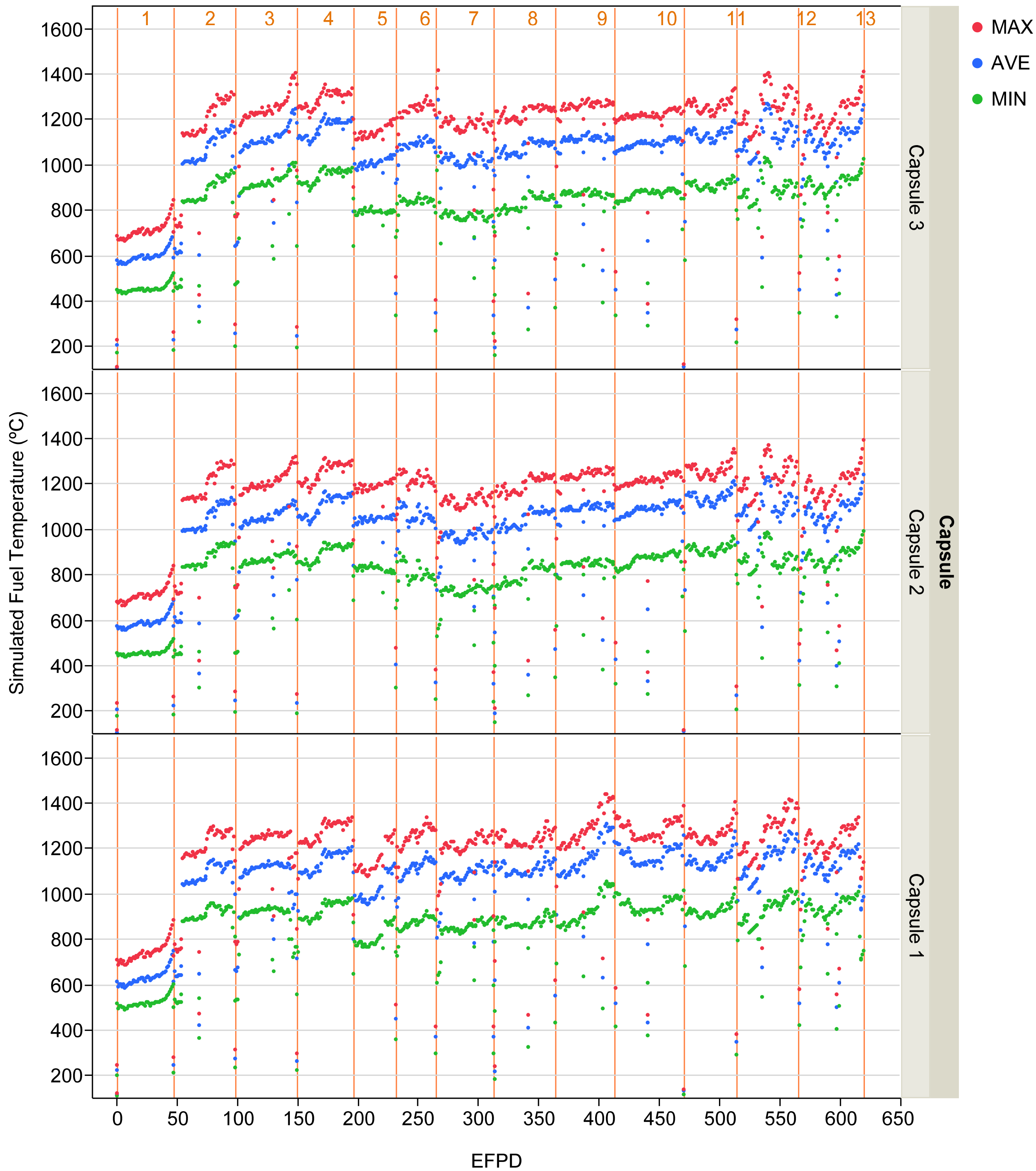


Figure 40. Temperature history of daily capsule minimum, maximum, and volume average, for Capsules 1–3.

Title: AGR-1 Daily As-run Thermal Analyses

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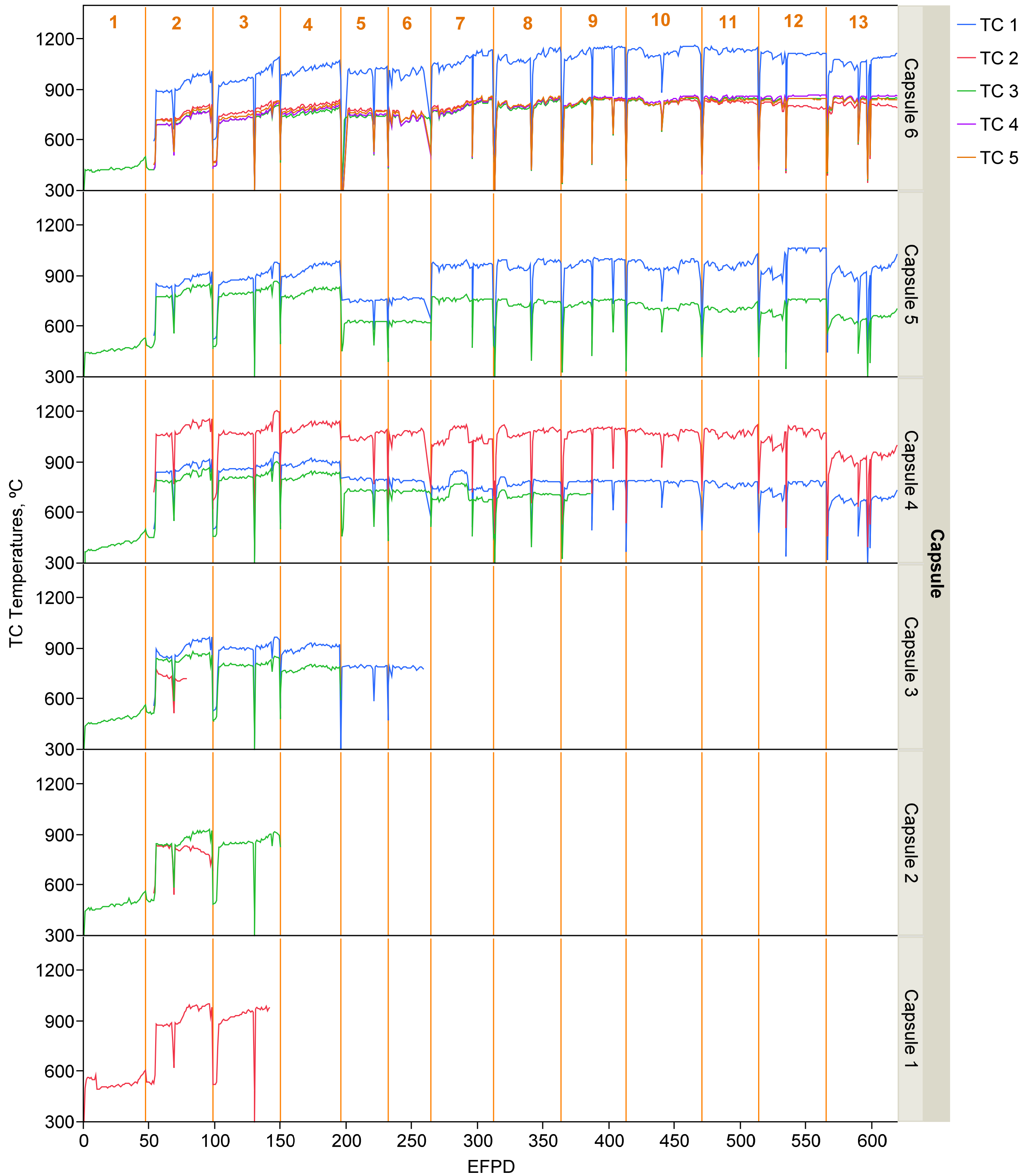

Figure 41. Recorded TC temperatures.

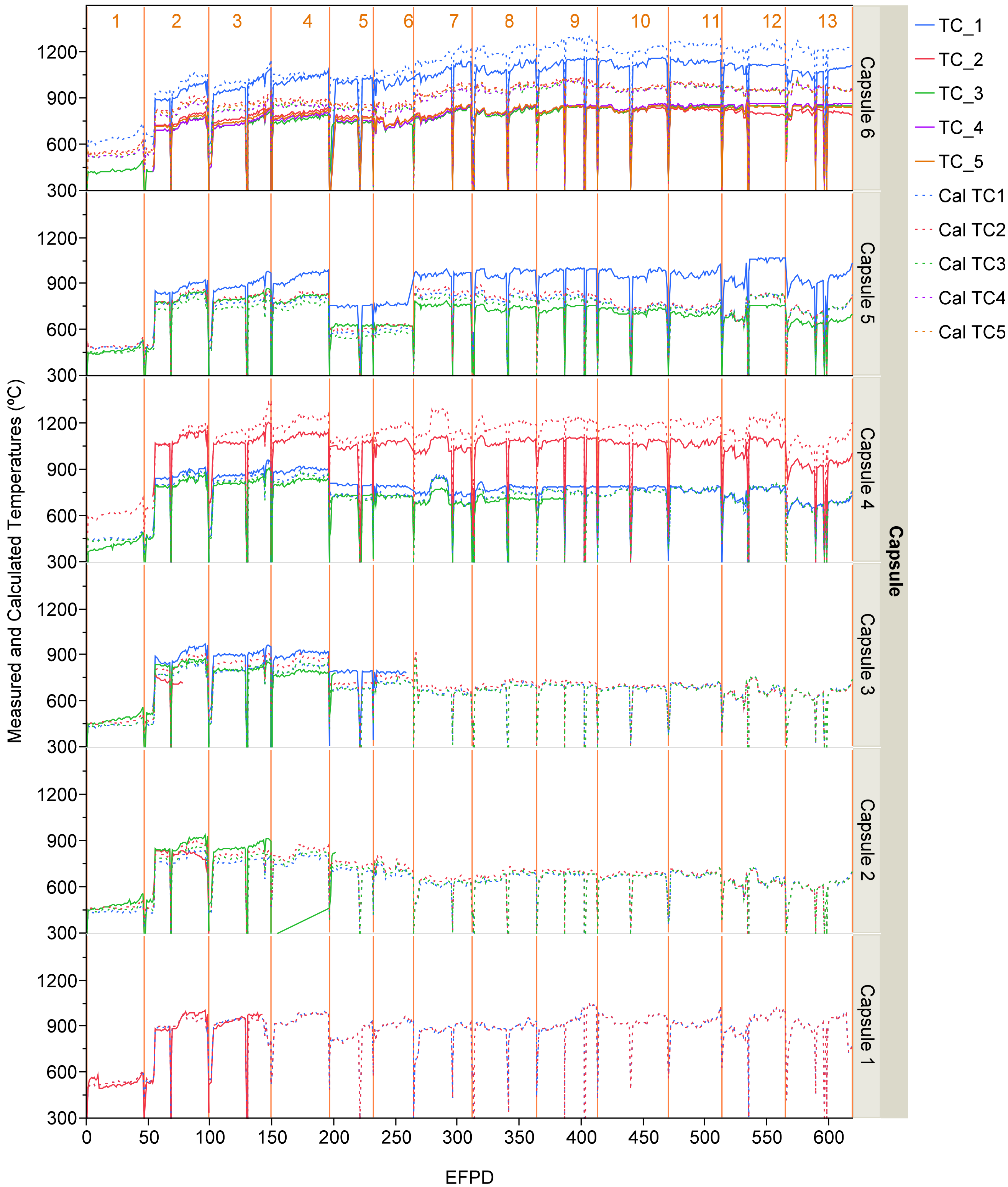

Figure 42. Measured and predicted TC temperatures.

The temperature difference shown in Figure 43 is defined as measured minus calculated. As noted above, TC-1 for Capsule 4 shows the closest correlation between measured and predicted. Most of the other differences in temperature appear to become greater with time. The TCs appear to be drifting and becoming more inaccurate as time goes on.

Time Average Volume Average Results

Figures 44 and 45 show the time average-volume average, time average maximum, and time average minimum fuel temperatures for Capsules 6 through 1. The time average-volume average value is described as

$$TAVA = \frac{\sum T_{ave,i} \Delta t_i}{\sum \Delta t_i} \qquad (8)$$

where *TAVA* is the time average-volume average capsule temperature, $T_{ave,i}$ is described in Equation 7, and Δt_i is the time difference from one time-step to the next.
All capsules appear to be slowly increasing at the end of irradiation. Capsule 5 shows a slight dip during Cycles 5 and 6 because of the large temperature decrease as described previously.

End of Irradiation Results

Figure 46 shows the TAVA values for each fuel compact for each stack and capsule at the very end of irradiation. Capsule 2 is noticeably cooler than Capsule 3 or 1. The top of Capsule 6 is plotted on the left side of the plot, while the bottom of Capsule 1 is on the right side of the plot. These final values (end of irradiation) of TAVA will be useful when doing PIE of the AGR-1 experiment. Figure 47 shows the time average peak temperature for each fuel compact, while Figure 48 shows the time average minimum temperature for each fuel compact. Tables 3 and 4 show the TAVA, time average maximum, and time average minimum.

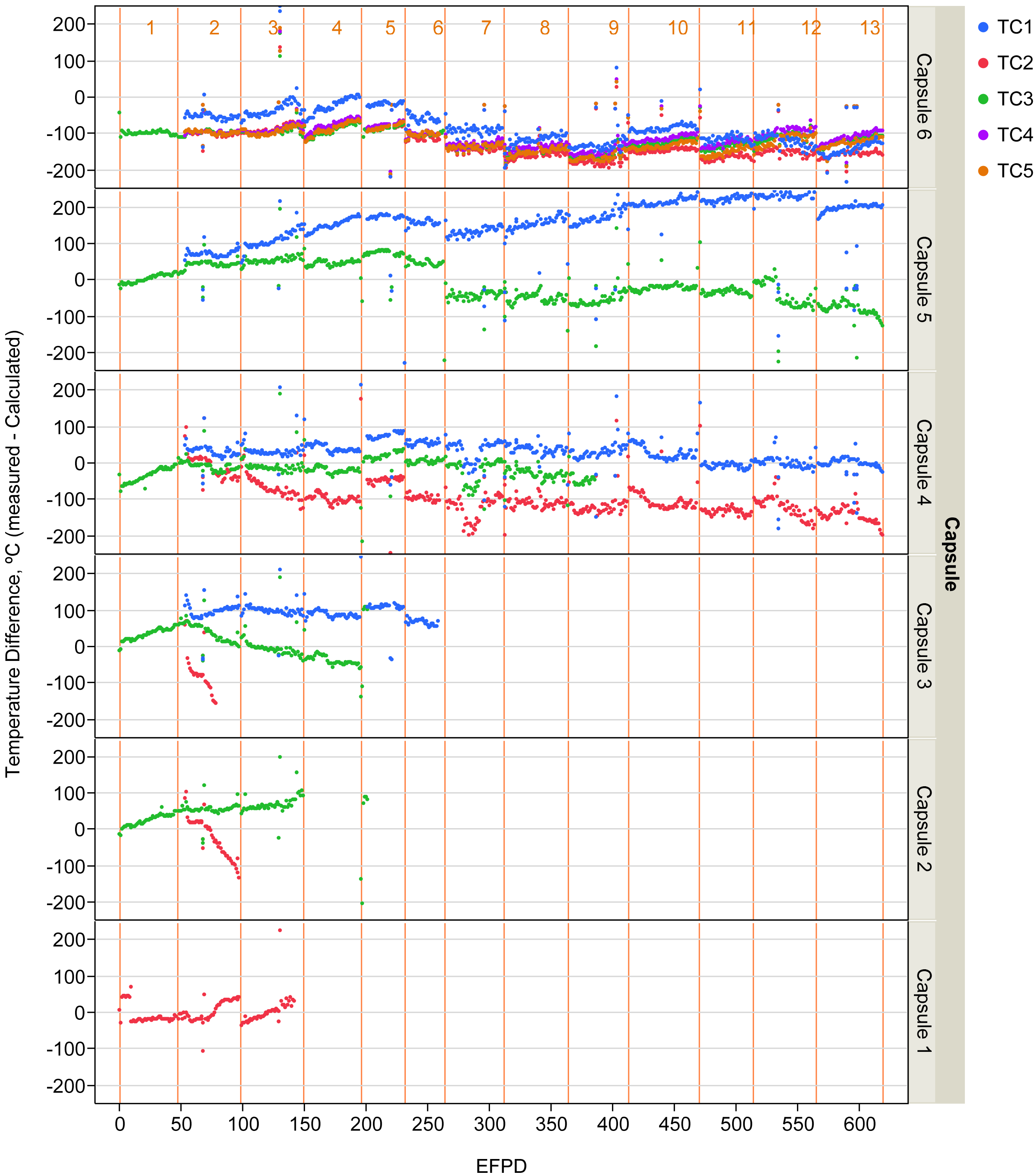

Figure 43. Difference between measured and predicted TC temperatures.

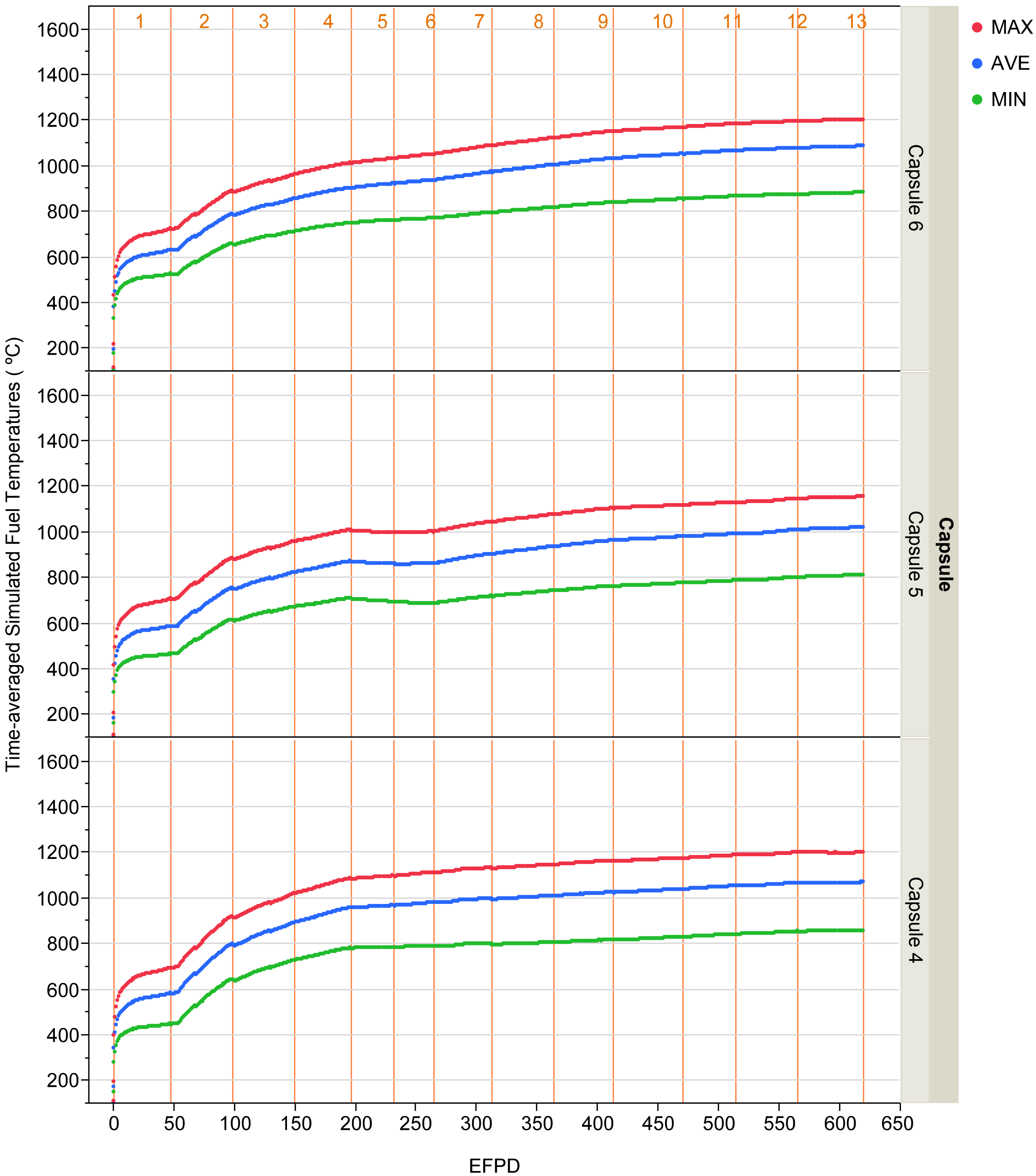

Figure 44. Time average minimum, time average maximum, and time average-volume average fuel temperatures for Capsules 6, 5, and 4.

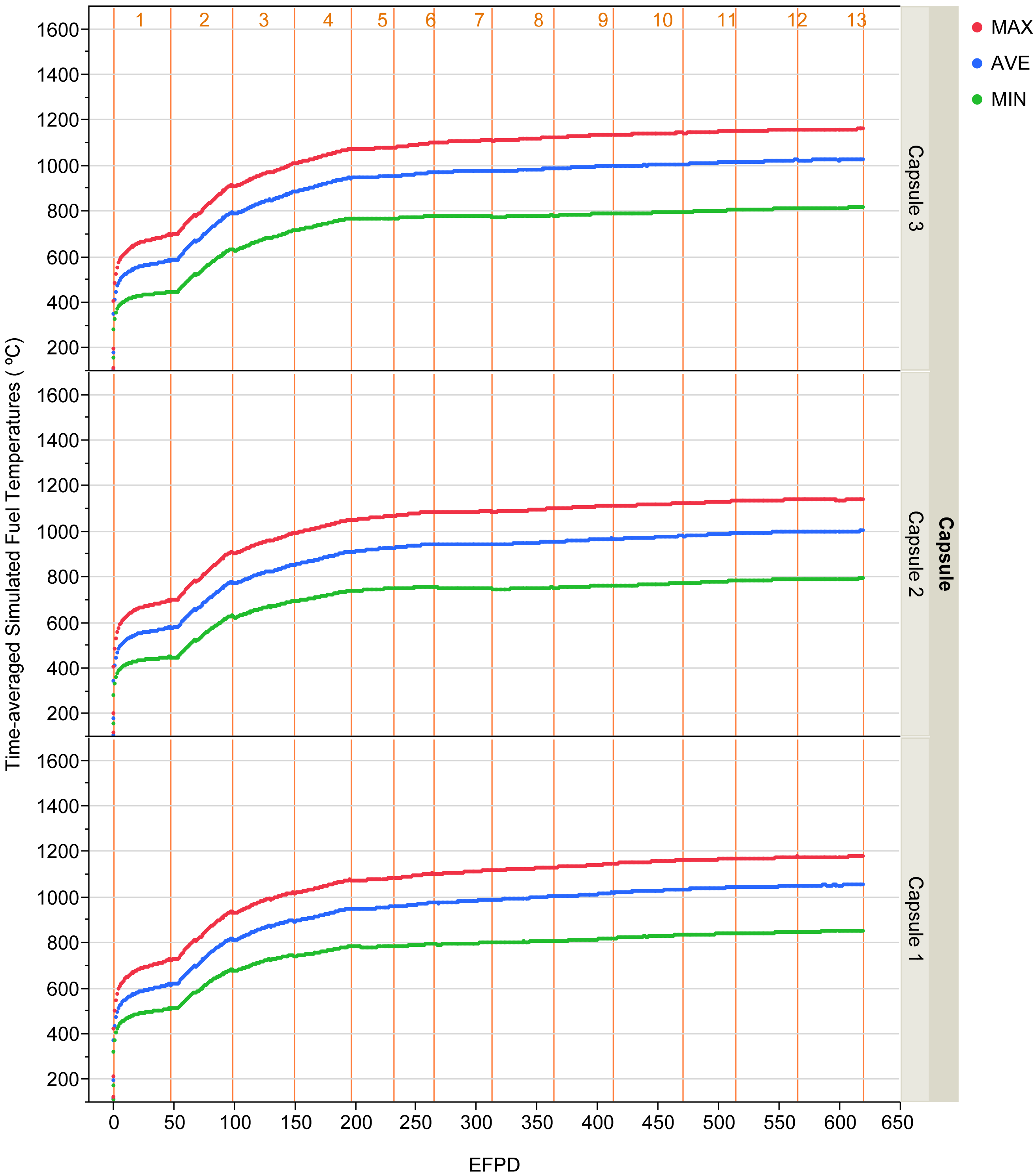

Figure 45. Time average minimum, time average maximum, and time average-volume average fuel temperatures for Capsules 3, 2, and 1.

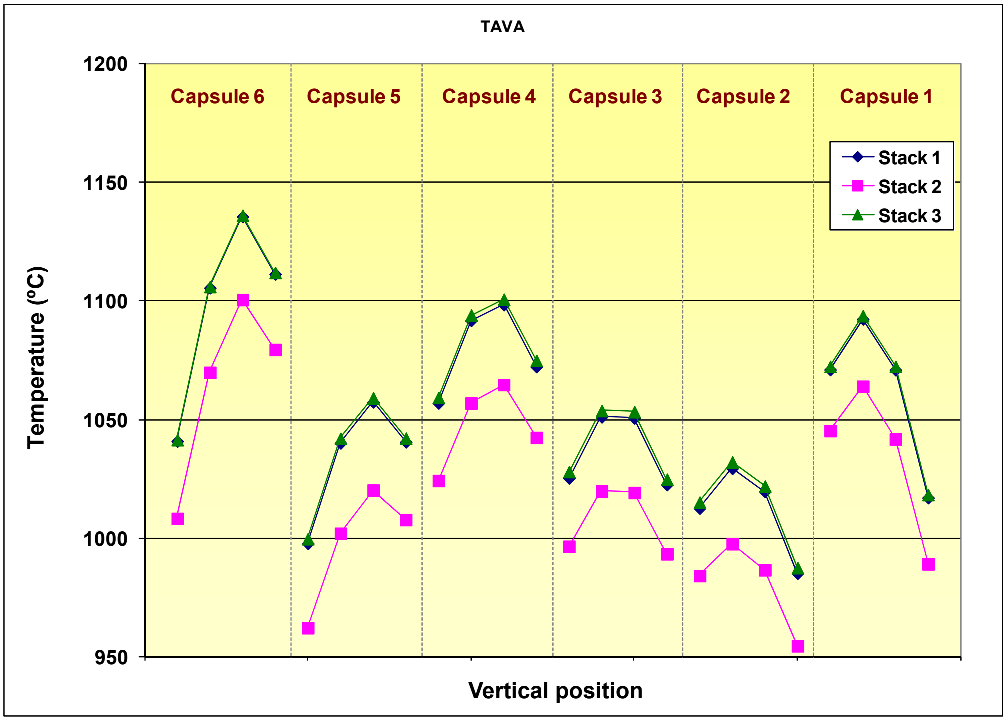

Figure 46. Time average volume average temperatures for fuel Compacts 1–4 for all stacks and all capsules at the very end of irradiation.

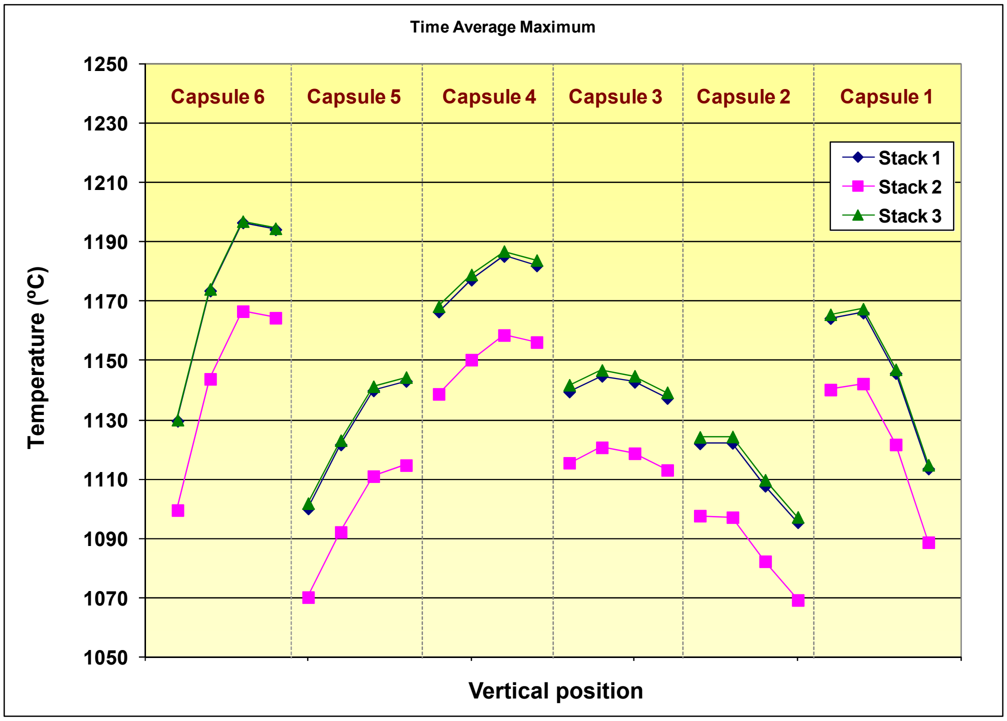

Figure 47. Time average peak temperatures for fuel Compacts 1–4 for all stacks and all capsules at the very end of irradiation.

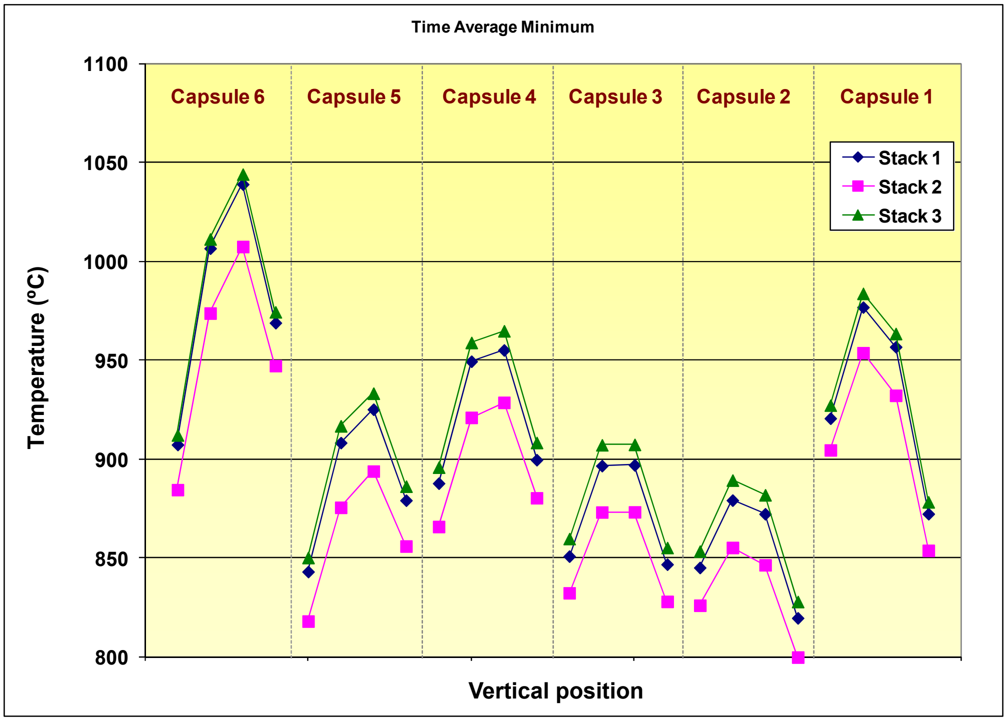

Figure 48. Time average minimum temperatures for fuel Compacts 1–4 for all stacks and all capsules at the very end of irradiation.

Table 3. Compact temperature data for Capsules 6–4 at the end of irradiation.

Capsule	Stack	Compact	TAVA Temperature (°C)	Time Average Minimum Temperature (°C)	Time Average Maximum Temperature (°C)
6 (top)	1	4	1041	908	1130
		3	1106	1007	1174
		2	1135	1039	1197
		1	1111	969	1194
	2	4	1008	885	1100
		3	1070	974	1144
		2	1101	1008	1167
		1	1079	947	1164
	3	4	1041	912	1130
		3	1106	1011	1174
		2	1136	1044	1197
		1	1112	975	1195
Capsule 6 Average			1087	973	1164
5	1	4	998	843	1100
		3	1040	908	1122
		2	1057	925	1140
		1	1041	879	1143
	2	4	962	818	1070
		3	1002	876	1092
		2	1020	894	1111
		1	1008	856	1115
	3	4	1000	850	1102
		3	1042	917	1123
		2	1059	933	1141
		1	1042	886	1144
Capsule 5 Average			1023	882	1117
4	1	4	1057	888	1166
		3	1092	950	1177
		2	1098	955	1185
		1	1072	900	1182
	2	4	1024	866	1139
		3	1057	921	1150
		2	1065	929	1159
		1	1042	881	1156
	3	4	1059	896	1168
		3	1094	959	1179
		2	1101	965	1187
		1	1075	909	1184
Capsule 4 Average			1070	918	1169

Table 4. Compact temperature data for Capsules 3–1 at the end of irradiation.

Capsule	Stack	Compact	TAVA Temperature (°C)	Time Average Minimum Temperature (°C)	Time Average Maximum Temperature (°C)
3	1	4	1025	851	1140
		3	1051	897	1145
		2	1051	897	1143
		1	1023	847	1137
	2	4	997	833	1116
		3	1020	873	1121
		2	1019	873	1119
		1	993	828	1113
	3	4	1028	860	1142
		3	1054	907	1147
		2	1053	908	1145
		1	1025	855	1139
Capsule 3 Average			1028	869	1134
2	1	4	1013	845	1122
		3	1029	879	1122
		2	1020	872	1108
		1	985	820	1095
	2	4	984	826	1098
		3	998	855	1097
		2	987	847	1082
		1	955	800	1069
	3	4	1015	854	1124
		3	1032	890	1124
		2	1022	882	1110
		1	988	828	1097
Capsule 2 Average			1002	850	1104
1 (bottom)	1	4	1071	921	1164
		3	1092	977	1166
		2	1071	957	1146
		1	1017	873	1114
	2	4	1045	905	1140
		3	1064	954	1142
		2	1042	932	1122
		1	989	854	1089
	3	4	1072	927	1166
		3	1094	984	1167
		2	1072	964	1147
		1	1018	878	1115
Capsule 1 Average			1054	927	1140

Comparison Between Normalized Volume Average Fuel Temperature and Log of R/B For Radionuclide Kr-85m

Since there was no fuel particle failure, the radionuclide release-to-birth ratios (R/Bs) are believed to closely follow capsule fuel temperature over time. Therefore comparison between fuel temperature and R/B will help to demonstrate that the calculated capsule fuel temperatures correctly reflect the capsule thermal condition. First, the volume average fuel temperature (T_{Nor}) and log of R/B for Kr-85m radionuclide ($Log(R/B)_{Nor}$) are normalized as in the following formula for fuel temperatures:

$$T_{norm,\,i} = \frac{T_u - \left(T_{ave,\,i} - T_{-2\sigma}\right)}{T_{+2\sigma} - T_{2\sigma}} \tag{8}$$

where $T_{norm,\,i}$ is the normalized daily temperature, T_i is the daily capsule average temperature, $T_{2\sigma}$ is two standard deviations, and $T_{ave,i}$ is the capsule average over all the entire irradiation. Equation 8 is also used to normalize the log (R/B).

To increase comparison accuracy, all data from the following conditions are excluded: ATR less-than-full power period, cool capsule conditions, and uncertain R/B value (too low) because of instrument measurement threshold. Thus, filtering was done on the data before the normalization for both parameters as follows:

- Cycle 138B (AGR-1 run on pure helium during the first cycle)
- Power less than 20 MW (during ATR power-up or -down period)
- Log R/B for Kr-85m less than -10
- Simulated TC-1 less than 600°C (to exclude all data from cool capsule conditions).

More filtering was done to exclude all normalized values that are below 0.0 as outliners. The filtered normalized final volume average fuel temperatures, together with the normalized log of R/B for Kr-85m are presented in Figure 49, showing that these two parameters are fairly close. However, to quantitatively demonstrate that ABAQUS calculated temperatures well described the radionuclide R/Bs, a Matched Pairs statistical method in SAS JMP software was used to compare the normalized log (R/B) and normalized fuel temperature. The results presented in Figure 50 show the clear match of normalized fuel temperature and log of R/B of Kr-85m. Figure 51 shows the difference with linear fits for four different zones of EFPDs. These four zones were chosen as they seemed to fit natural trends in the differences. It is hard to say why these definite trends exist. Capsules 3 and 2 are very similar. It appears that both differences are linearly increasing during the Zone 4 period that covers the last three operating cycles. Figure 52 shows a small standard error (Panel 2) and high correlation coefficients (Panel 3) for all capsules. The standard error (standard error in Panel 2 of Figure 52) formula is expressed as

$$SE_{diff} = \sqrt{\frac{\sum_{i=1,N} (T_{Nor,i} - Log(R/B)_{Nor,i})^2}{N-1}} \tag{9}$$

where N is number of data points and $T_{Nor,i}$, $Log(R/B)_{Nor,i}$ are normalized volume average fuel temperature and log of R/B for
Kr-85m radionuclide at the time *i*. It appears that there is a fairly good correlation shown in the third panel of Figure 52 between the two normalized values. Capsules 5, 4, and 1 have the highest correlation.

Figure 53 shows the capsule mean and 95% confidence level (two standard deviations) of differences between the two normalized values. Anywhere on the plot that the green triangles intersect the average, the confidence is high. Figure 54 shows the same parameters for the four different time zones of each capsule. Notice the trend for Capsules 4 and 2 where the values have the same relative trends for the four time zones. Capsule 3 could be included in this group if the first time zone was lower than the second.

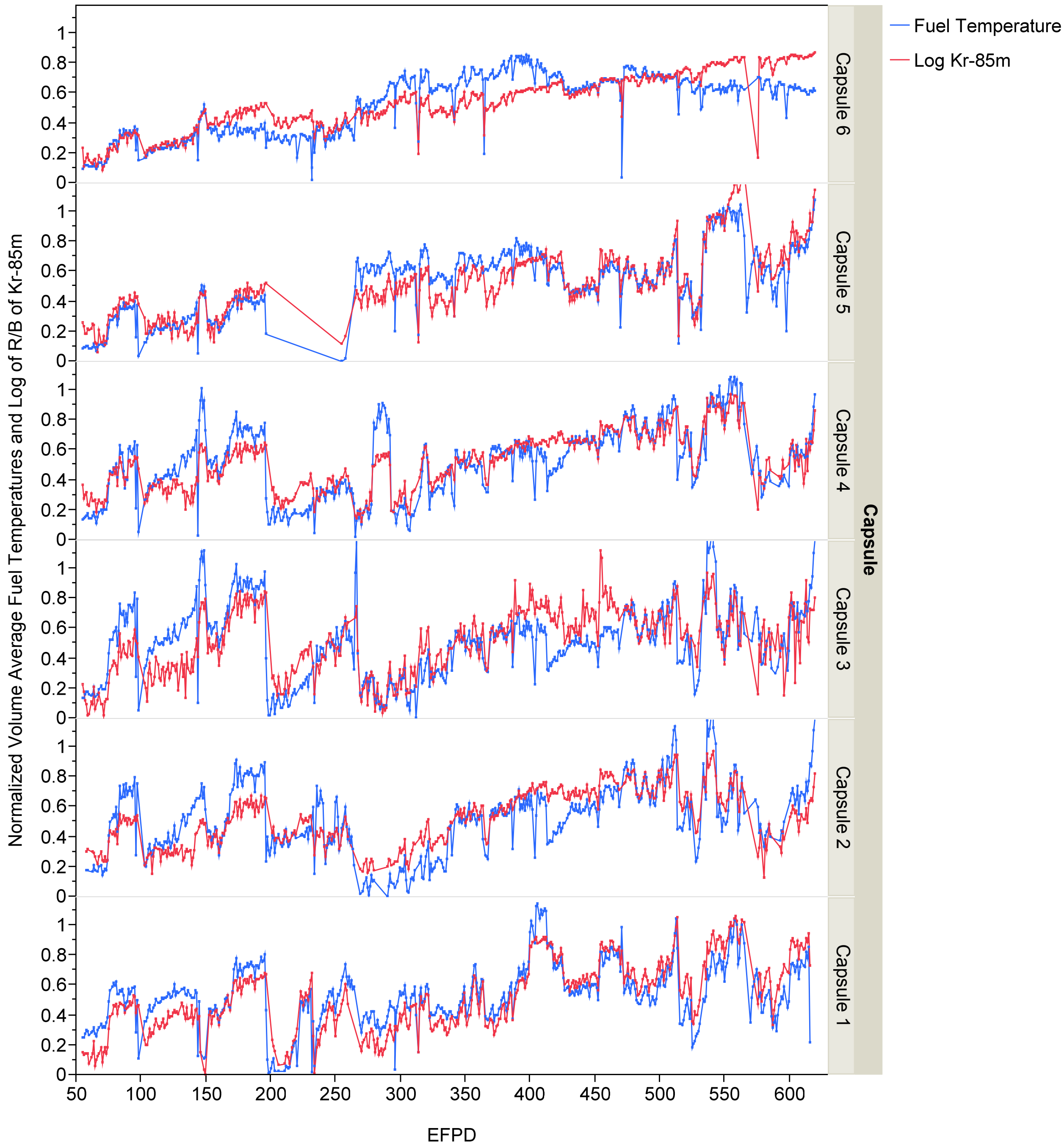

Figure 49. Final normalized volume average fuel temperatures and normalized log of Kr-85m R/B as a function of EFPD.

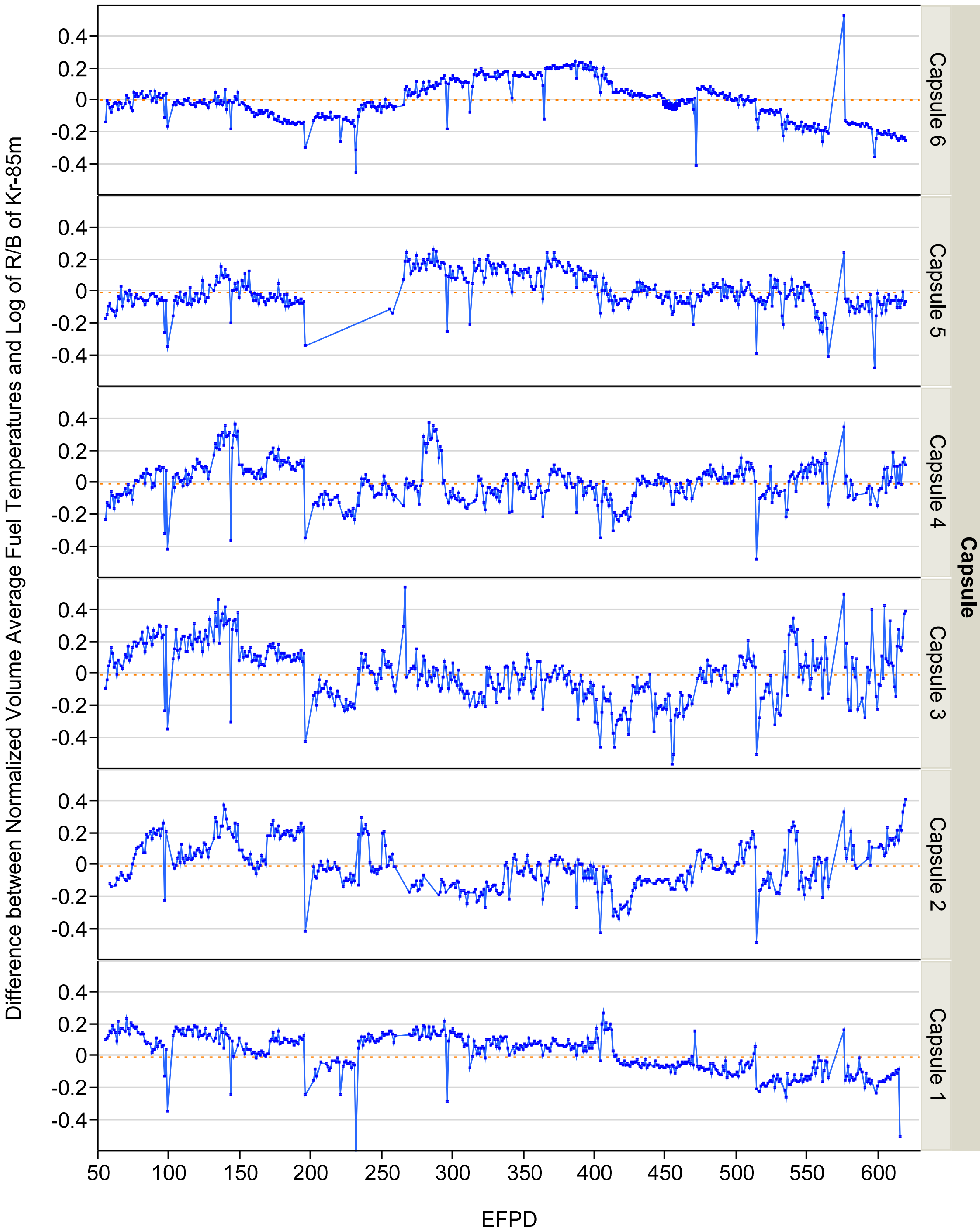

Figure 50. Difference between normalized volume average fuel temperatures and log of R/B of Kr-85m.

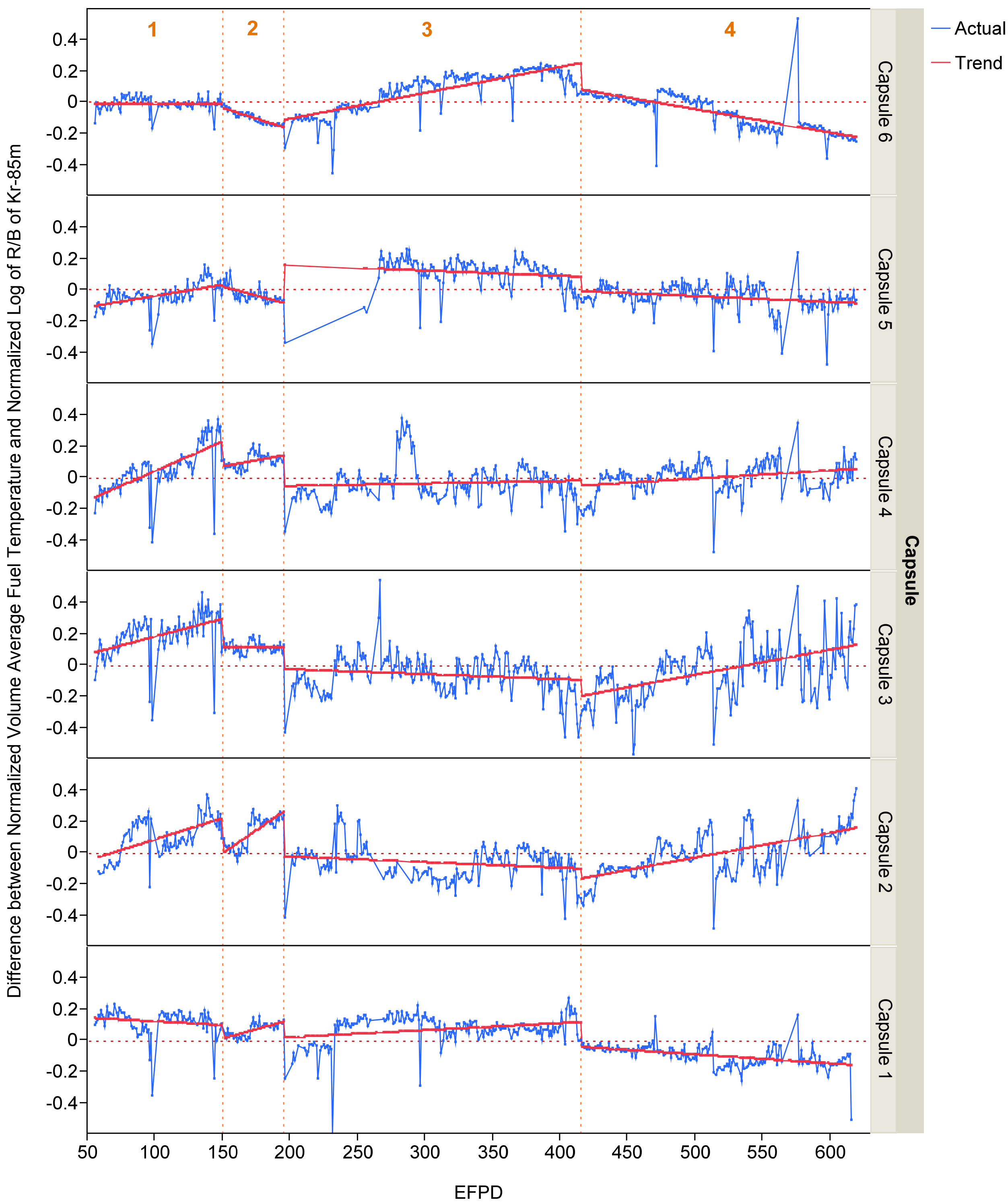

Figure 51. Difference between final normalized volume average fuel temperatures and normalized log of Kr-85m R/B as function of EFPD with linear projections.

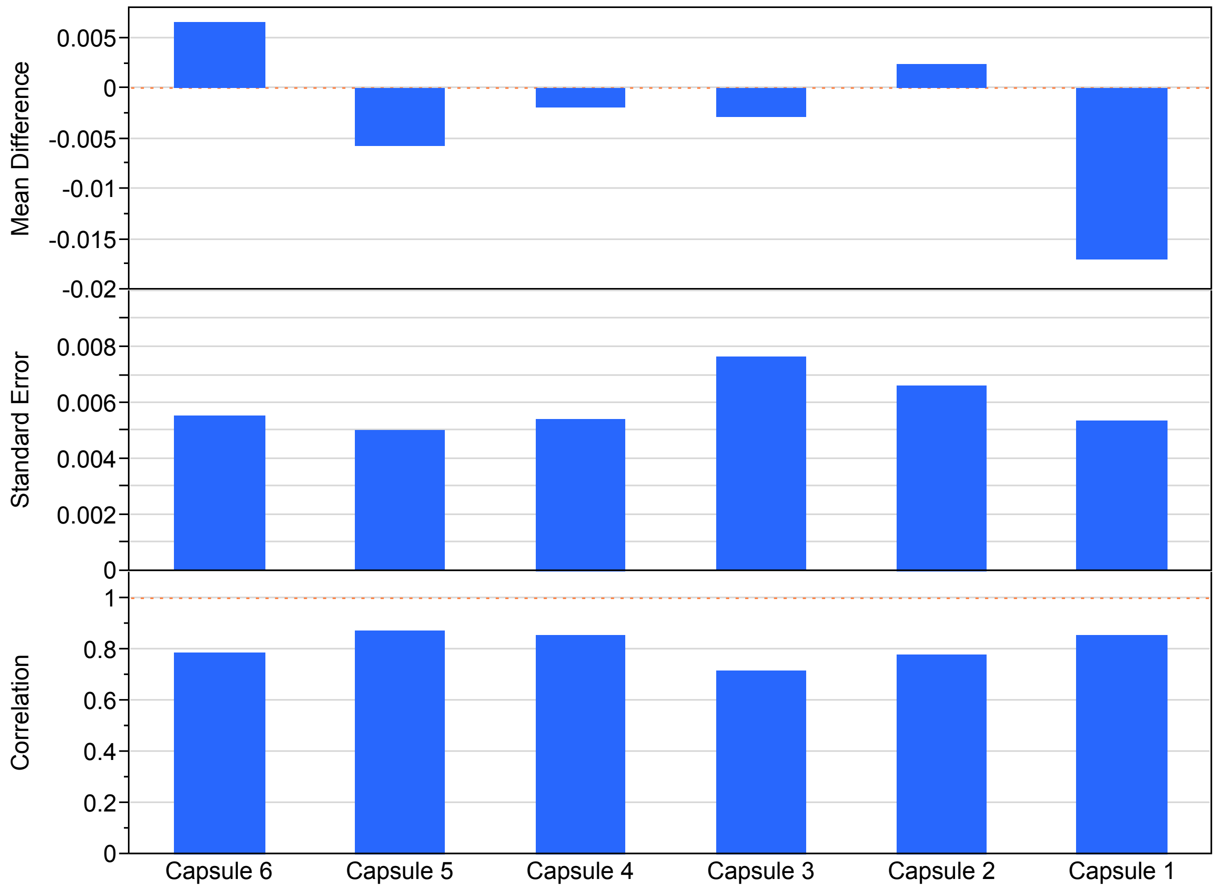

Figure 52. Capsule statistics of differences between normalized volume average fuel temperatures and normalized log of Kr-85m R/B.

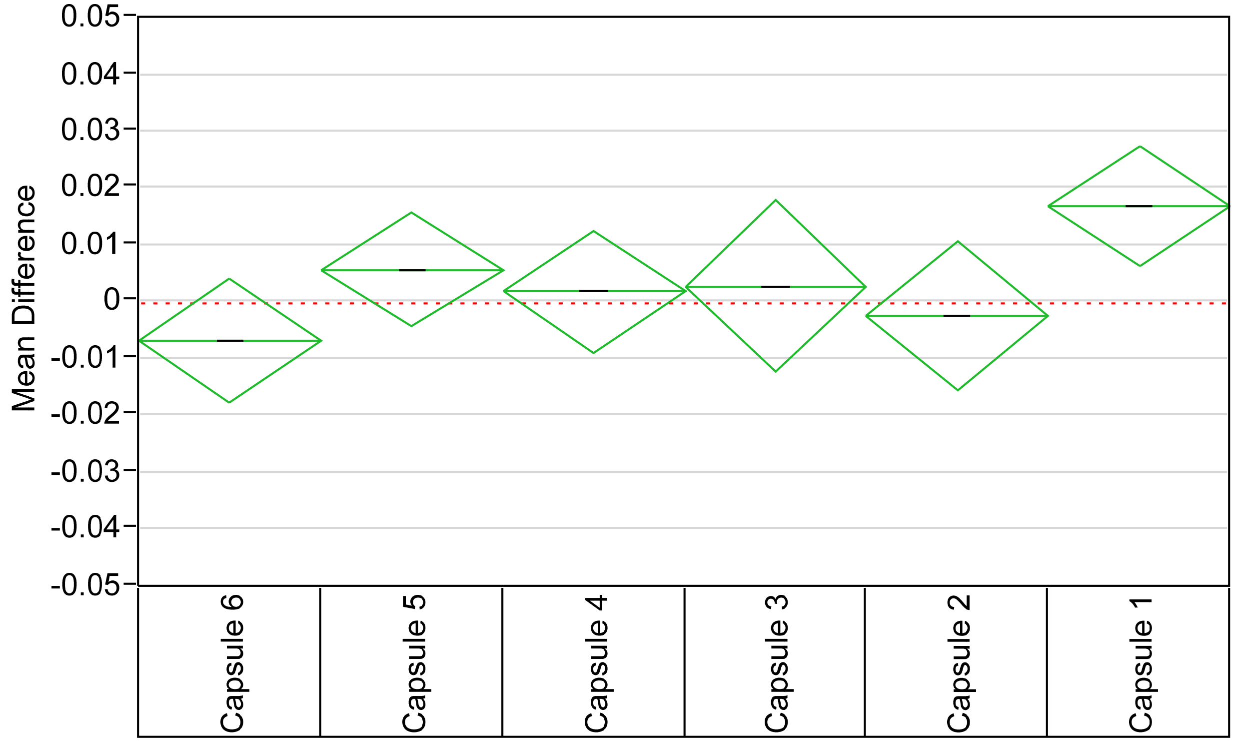

Figure 53. Capsule mean and 95% confidence level (two standard deviations) of differences between final normalized volume average fuel temperatures and normalized log of Kr-85m R/B.

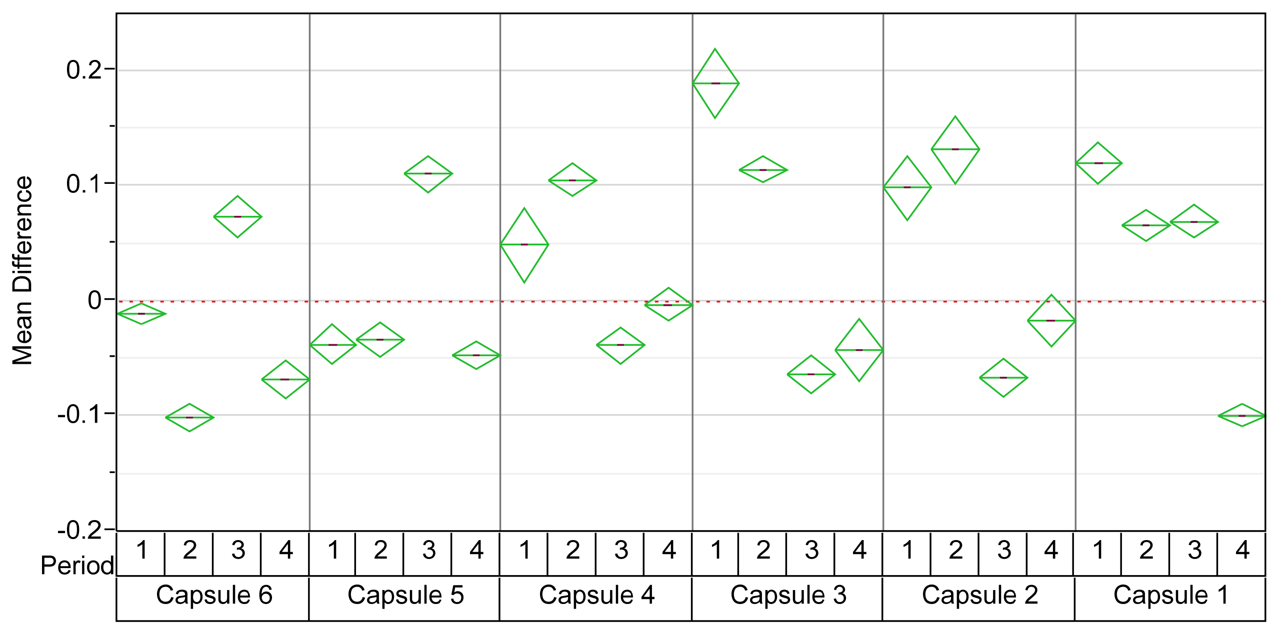

Figure 54. Capsule mean and 95% confidence level (two standard deviations) of differences between final normalized volume average fuel temperatures and normalized log of Kr-85m R/B for each selected period of time as in Figure 50.

DATA RETENTION

All data files to produce the temperature results are on the Icestorm computer in the haw/agr/dailycalcs directory; Appendix C shows the structure of these files. The NDMAS database has all of the heat rate data for all components and temperatures of all fuel compacts. Data will be retained on Icestorm for several years. Figure 49 shows the files used on the windows machine that produced the Excel files. The purpose of these folders and files are described in Table 5. Revision 0 of this report shows the files that were used in development of the model. Table 5 in Revision 1 shows the final files for this revision.

Table 5. Purpose files.

File	Purpose
AGR-1 compact thermal data run 2B End of Irradiation Temperatures.xlsx	Data and plots for Figures 46-48
Conductivity Ratios for Run 2B.xlsx	Conductivity ratios for gaps changing with time
Master Output AGR Daily Calcs.xlsx	All fuel compact temperatures and TAVA for all capsules
Comparison between …	Plots created from NDMAS data for normalized temperatures compared to normalized log (R/B)

AGR-1 compact thermal data Run 2B End of Irradiation Temperatures.xlsx	57 KB	Microsoft Office Exc...	12/5/2011 9:37 AM
Conductivity Ratios for Run 2B.xlsx	336 KB	Microsoft Office Exc...	8/8/2011 3:16 PM
Master Output AGR DailyCalcs Run_2b.xlsx	12,478 KB	Microsoft Office Exc...	6/24/2011 9:28 AM
Master Output AGR DailyCalcs Run_2b_Final hour_column_added.xlsx	12,193 KB	Microsoft Office Exc...	11/28/2011 2:28 PM
Comparison between normalized fuel temperature Run 2 and log(R_B with linear fits).docx	1,255 KB	Microsoft Office Wo...	8/17/2011 12:51 PM
Comparison between normalized fuel temperature Run 2 and log(R_B).docx	775 KB	Microsoft Office Wo...	8/17/2011 7:21 AM
Comparison between normalized fuel temperature Runs 1 and 2 and log(R_B).docx	1,255 KB	Microsoft Office Wo...	8/16/2011 9:27 AM
Run2B Report Plots.docx	3,126 KB	Microsoft Office Wo...	7/13/2011 7:11 AM

Figure 49. AGR-1 files for final run (Run 2B).

Appendix D has the entire data structure on Icestorm.

Each cycle directory has all of the input files and results for the calculations. The ABAQUS output files end in .dat and .fil. The TAVA data ends in .outc. Input that is added to the base file for daily heat rates, gas flows, and fluences end in .steps. Directory 138B contains the master file writer step_writer.f that creates the .steps files. This 138B directory also contains agrcomp_reader.f, which reads the .fil files and calculates the TAVA data and outputs the .outc files. Also included in the directory are the files in the AGR1 file directory that was set up special for this project. This area is shared between the physics calculations and the thermal analysis. The gas mixtures, compact heat rates, compact fluences, graphite heat rates, graphite fluences, and component heat rates all come from these files.

CONCLUSIONS AND RECOMMENDATIONS

This report documents the results of thermal analyses to predict the daily as-run temperatures for the AGR-1 experiment. Control gas gaps and compact-graphite holder gas gaps changed linearly with time, matching actual measurements after irradiation. Daily heat rates for each compact and component in the models were input from daily as-run physics analyses. Daily gas compositions and component fluences were also input. Six different finite element models were created for the six different AGR-1 capsules. Each capsule had a different gas gap that was implemented to control the temperature of the experiment. Capsules on the top and bottom had larger gas gaps, while capsules in the middle were smaller.

Gas mixture thermal conductivity was implemented using the kinetic theory of gases. Fluence and temperature dependent thermal conductivity was used for the graphite components and the fuel compacts. Radiation heat transfer was implemented with emissivity of all surfaces being 1.0 and 0.99 in order to match, as closely as possible, the experimental TC temperatures.

In general, most predicted temperatures were hotter than the measured TC temperatures. Many of the TCs failed during the experiment. Heat rates, and hence temperatures, were very sensitive to the outer shim control cylinders as shown at the end of the 3rd cycle (139B). Volume average time average temperature values were calculated in order to be used in the PIE.

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APPENDIX A—ABAQUS Version 6.8-2 Validation Report on Icestorm

```
ABQ EXE: abq682
COMPUTER: service0_ice_inel_gov
OS: Linux
OS TYPE: 2.6.16.60-0.37_f594963d-smp
t1
=======================================================
ODB: Test-1
#####  #####
         NT11-n325
Max error: 1.20% <----------
    Max1:  37.3320     Min1:  10.5200 Range:  26.8120
Abq Max2:  37.7813 Abq Min2:  10.6362 Range:  27.1451
         NT11-n281
Max error: 1.48% <----------
    Max1:  55.1070     Min1:  13.9970 Range:  41.1100
Abq Max2:  54.7760 Abq Min2:  14.2043 Range:  40.5717
=======================================================
t2
=======================================================
ODB: Test-2
#####  #####
         NT15-n61
Max error: 1.34% <----------
    Max1:  37.3320     Min1:  10.5200 Range:  26.8120
Abq Max2:  37.7366 Abq Min2:  10.6609 Range:  27.0756
#####  #####
         NT11-n61
Max error: 1.54% <----------
    Max1:  55.1070     Min1:  13.9970 Range:  41.1100
Abq Max2:  54.7444 Abq Min2:  14.2131 Range:  40.5313
=======================================================
t3
=======================================================
ODB: Test-3
#####  #####
         NT11-n130
Max error: 1.65% <----------
    Max1:  44.5920     Min1:  12.5210 Range:  32.0710
Abq Max2:  44.7825 Abq Min2:  12.7270 Range:  32.0555
         NT11-n59
Max error: 1.85% <----------
    Max1:  55.3390     Min1:  14.7770 Range:  40.5620
Abq Max2:  55.0396 Abq Min2:  15.0511 Range:  39.9885
=======================================================
t4
=======================================================
ODB: Test-4
#####  #####
         NT11-n281
Error: 0.00%     <----------
Ans:       13.7600       Abq:       13.7600
         NT11-n303
Error: 0.00%     <----------
Ans:       11.3200       Abq:       11.3200
         NT11-n325
Error: 0.00%     <----------
Ans:        4.0000       Abq:        4.0000
         NT11-n314
Error: 0.00%     <----------
Ans:        8.2700       Abq:        8.2700
         NT11-n292
Error: 0.00%     <----------
Ans:       13.1500       Abq:       13.1500
=======================================================
t5
=======================================================
ODB: Test-5
#####  #####
         NT13-n62
Error: 0.00%     <----------
Ans:       11.3200       Abq:       11.3200
#####  #####
         NT12-n62
Error: 0.00%     <----------
Ans:       13.1500       Abq:       13.1500
#####  #####
         NT11-n62
Error: 0.00%     <----------
Ans:       13.7600       Abq:       13.7600
#####  #####
         NT15-n62
Error: 0.00%     <----------
Ans:        4.0000       Abq:        4.0000
#####  #####
         NT14-n62
Error: 0.00%     <----------
Ans:        8.2700       Abq:        8.2700
=======================================================
t6
=======================================================
ODB: Test-6
#####  #####
         NT11-n533
Max error: 0.39% <----------
    Max1:  80.7640     Min1:  61.8970 Range:  18.8670
Abq Max2:  80.4914 Abq Min2:  61.7364 Range:  18.7551
         NT11-n803
Max error: 0.38% <----------
    Max1:  94.5930     Min1:  71.5310 Range:  23.0620
Abq Max2:  94.3007 Abq Min2:  71.2781 Range:  23.0226
=======================================================
t7
=======================================================
ODB: Test-7
#####  #####
         HFL-e56
Error: 0.19%     <----------
Ans:       -0.1700       Abq:       -0.1697
=======================================================
t8
=======================================================
ODB: Test-8
#####  #####
         HFL-e1121
Error: 1.74%     <----------
Ans:        0.1710       Abq:        0.1740
         HFL-e3678
Error: 2.25%     <----------
Ans:       -0.1620       Abq:       -0.1656
=======================================================
t9
=======================================================
ODB: Test-9
#####  #####
         NT11-n13
Error: 0.01%     <----------
Ans:       50.0010       Abq:       50.0036
         NT11-n17
Error: 0.00%     <----------
Ans:       55.5500       Abq:       55.5500
         NT11-n328
Error: 0.20%     <----------
Ans:       51.6040       Abq:       51.7074
         NT11-n38
Error: 0.05%     <----------
Ans:       50.0890       Abq:       50.1148
         NT11-n28
Error: 0.11%     <----------
Ans:       50.7010       Abq:       50.7550
         NT11-n218
Error: 0.01%     <----------
Ans:       50.0110       Abq:       50.0176
         NT11-n32
Error: 0.10%     <----------
Ans:       50.3060       Abq:       50.3555
         NT11-n324
Error: 0.20%     <----------
Ans:       52.4260       Abq:       52.5321
         NT11-n4
Error: 0.08%     <----------
Ans:       51.0600       Abq:       51.1006
         NT11-n320
```

```
Error: 0.16%     <----------
Ans:       53.6690       Abq:       53.7552
=======================================================
t10
=======================================================
ODB: Test-10
#####  #####
         NT11-n325
Error: 0.15%     <----------
Ans:      215.7130       Abq:      216.0345
=======================================================
t11
=======================================================
ODB: Test-11
#####  #####
         HFL-e55
Error: 0.02%     <----------
Ans:       -5.5000       Abq:       -5.4989
=======================================================
t12
=======================================================
ODB: Test-12
#####  #####
         NT11-n336
Error: 0.00%     <----------
Ans:      406.6667       Abq:      406.6667
=======================================================
```

APPENDIX B—Material Properties Used in ABAQUS

Capsule 1

```
** MATERIALS
**
*Material, name=BE
*Conductivity
  0.001968, 100.
 0.0001319,1000.
*Density
 0.066,
*Elastic
 1e+06,0.
*Expansion
 1.333e-05,
*Specific Heat
 0.5,
*Material, name=FUEL
*Conductivity, dependencies=2
 0.0001501,1472.,   0.,   0.
 0.0001406,1742.,   0.,   0.
 0.0001348,2012.,   0.,   0.
 0.0001318,2282.,   0.,   0.
 0.0001313,2642.,   0.,   0.
 0.0001501,1472.,   1.,   0.
 0.0001406,1742.,   1.,   0.
 0.0001348,2012.,   1.,   0.
 0.0001318,2282.,   1.,   0.
 0.0001313,2642.,   1.,   0.
 0.0001232,1472.,   0.,  0.5
 0.0001233,1742.,   0.,  0.5
 0.0001247,2012.,   0.,  0.5
 0.0001277,2282.,   0.,  0.5
  0.000135,2642.,   0.,  0.5
 0.0001232,1472.,   1.,  0.5
 0.0001233,1742.,   1.,  0.5
 0.0001247,2012.,   1.,  0.5
 0.0001277,2282.,   1.,  0.5
  0.000135,2642.,   1.,  0.5
 0.0001056,1472.,   0.,   1.
 0.0001108,1742.,   0.,   1.
 0.0001168,2012.,   0.,   1.
 0.0001242,2282.,   0.,   1.
 0.0001388,2642.,   0.,   1.
 0.0001056,1472.,   1.,   1.
 0.0001108,1742.,   1.,   1.
 0.0001168,2012.,   1.,   1.
 0.0001242,2282.,   1.,   1.
 0.0001388,2642.,   1.,   1.
  8.59e-05,1472.,   0.,   2.
 9.463e-05,1742.,   0.,   2.
 0.0001051,2012.,   0.,   2.
 0.0001187,2282.,   0.,   2.
 0.0001463,2642.,   0.,   2.
  8.59e-05,1472.,   1.,   2.
 9.463e-05,1742.,   1.,   2.
 0.0001051,2012.,   1.,   2.
 0.0001187,2282.,   1.,   2.
 0.0001463,2642.,   1.,   2.
 7.608e-05,1472.,   0.,   3.
 8.511e-05,1742.,   0.,   3.
 9.712e-05,2012.,   0.,   3.
 0.0001146,2282.,   0.,   3.
 0.0001538,2642.,   0.,   3.
 7.608e-05,1472.,   1.,   3.
 8.511e-05,1742.,   1.,   3.
 9.712e-05,2012.,   1.,   3.
 0.0001146,2282.,   1.,   3.
 0.0001538,2642.,   1.,   3.
  7.02e-05,1472.,   0.,   4.
 7.881e-05,1742.,   0.,   4.
 9.134e-05,2012.,   0.,   4.
 0.0001116,2282.,   0.,   4.
 0.0001614,2642.,   0.,   4.
  7.02e-05,1472.,   1.,   4.
 7.881e-05,1742.,   1.,   4.
 9.134e-05,2012.,   1.,   4.
 0.0001116,2282.,   1.,   4.
 0.0001614,2642.,   1.,   4.
 6.589e-05,1472.,   0.,   5.
 7.406e-05,1742.,   0.,   5.
 8.685e-05,2012.,   0.,   5.
 0.0001092,2282.,   0.,   5.
 0.0001691,2642.,   0.,   5.
 6.589e-05,1472.,   1.,   5.
 7.406e-05,1742.,   1.,   5.
 8.685e-05,2012.,   1.,   5.
 0.0001092,2282.,   1.,   5.
 0.0001691,2642.,   1.,   5.
*Density
 0.000981,
*Expansion
 3.88084e-06,
*Specific Heat
 4.89,
*Material, name=GRAFOIL
*Conductivity, type=ORTHO
  0.001852,  0.001852, 6.944e-05,       70.
 0.0007716, 0.0007716, 3.858e-05,     1500.
 0.0002315, 0.0002315, 3.858e-05,     3500.
*Density
 0.0628,
*Specific Heat
 0.3,
*Material, name=GRAPH
*Conductivity, dependencies=2
  0.001095,  572.,    0.,    0.
 0.0006021, 1292.,    0.,    0.
 0.0005085, 1652.,    0.,    0.
 0.0004282, 2282.,    0.,    0.
  0.001095,  572.,    1.,    0.
 0.0006021, 1292.,    1.,    0.
 0.0005085, 1652.,    1.,    0.
 0.0004282, 2282.,    1.,    0.
  8.99e-05,  572.,    0., 0.001
 0.0002392, 1292.,    0., 0.001
 0.0002821, 1652.,    0., 0.001
 0.0003557, 2282.,    0., 0.001
  8.99e-05,  572.,    1., 0.001
 0.0002392, 1292.,    1., 0.001
 0.0002821, 1652.,    1., 0.001
 0.0003557, 2282.,    1., 0.001
 0.0001335,  572.,    0.,  0.01
  0.000255, 1292.,    0.,  0.01
  0.000292, 1652.,    0.,  0.01
 0.0003589, 2282.,    0.,  0.01
 0.0001335,  572.,    1.,  0.01
  0.000255, 1292.,    1.,  0.01
  0.000292, 1652.,    1.,  0.01
 0.0003589, 2282.,    1.,  0.01
  0.000177,  572.,    0.,   0.1
 0.0002708, 1292.,    0.,   0.1
 0.0003019, 1652.,    0.,   0.1
 0.0003621, 2282.,    0.,   0.1
  0.000177,  572.,    1.,   0.1
 0.0002708, 1292.,    1.,   0.1
 0.0003019, 1652.,    1.,   0.1
 0.0003621, 2282.,    1.,   0.1
 0.0002206,  572.,    0.,    1.
 0.0002865, 1292.,    0.,    1.
 0.0003117, 1652.,    0.,    1.
 0.0003653, 2282.,    0.,    1.
 0.0002206,  572.,    1.,    1.
 0.0002865, 1292.,    1.,    1.
 0.0003117, 1652.,    1.,    1.
 0.0003653, 2282.,    1.,    1.
  0.000251,  572.,    0.,    5.
 0.0002976, 1292.,    0.,    5.
 0.0003186, 1652.,    0.,    5.
 0.0003675, 2282.,    0.,    5.
  0.000251,  572.,    1.,    5.
 0.0002976, 1292.,    1.,    5.
 0.0003186, 1652.,    1.,    5.
 0.0003675, 2282.,    1.,    5.
*Density
 0.0628,
*Specific Heat
 0.3,
*Material, name=GRAPH55
**** DPA = Fluence (n/m**2) X 8.23e-26 for graphite (Sterbentz
Letter)
**** based on k(irr)=((0.25-
0.00017*T(irr))*A*log(DPA)+0.000683*T(irr))*k(non)
**** A = -1.0, Temp in deg C for correlation
** 5.5% Boron Graphtec
** cond,  temp,  %Ne,  Fluence
*Conductivity, dependencies=2
  0.001095,  572.,    0.,    0.
 0.0006021, 1292.,    0.,    0.
 0.0005085, 1652.,    0.,    0.
 0.0004282, 2282.,    0.,    0.
  0.001095,  572.,    1.,    0.
 0.0006021, 1292.,    1.,    0.
 0.0005085, 1652.,    1.,    0.
 0.0004282, 2282.,    1.,    0.
 0.0008961,  572.,    0., 0.001
 0.0005312, 1292.,    0., 0.001
 0.0004647, 1652.,    0., 0.001
 0.0004151, 2282.,    0., 0.001
```

```
 0.0008961,  572.,    1., 0.001
 0.0005312, 1292.,    1., 0.001
 0.0004647, 1652.,    1., 0.001
 0.0004151, 2282.,    1., 0.001
 0.0006783,  572.,    0.,  0.01
 0.0004523, 1292.,    0.,  0.01
 0.0004154, 1652.,    0.,  0.01
  0.000399, 2282.,    0.,  0.01
 0.0006783,  572.,    1.,  0.01
 0.0004523, 1292.,    1.,  0.01
 0.0004154, 1652.,    1.,  0.01
  0.000399, 2282.,    1.,  0.01
 0.0004605,  572.,    0.,   0.1
 0.0003734, 1292.,    0.,   0.1
 0.0003661, 1652.,    0.,   0.1
  0.000383, 2282.,    0.,   0.1
 0.0004605,  572.,    1.,   0.1
 0.0003734, 1292.,    1.,   0.1
 0.0003661, 1652.,    1.,   0.1
  0.000383, 2282.,    1.,   0.1
 0.0002427,  572.,    0.,    1.
 0.0002945, 1292.,    0.,    1.
 0.0003167, 1652.,    0.,    1.
 0.0003669, 2282.,    0.,    1.
 0.0002427,  572.,    1.,    1.
 0.0002945, 1292.,    1.,    1.
 0.0003167, 1652.,    1.,    1.
 0.0003669, 2282.,    1.,    1.
 9.042e-05,  572.,    0.,    5.
 0.0002394, 1292.,    0.,    5.
 0.0002823, 1652.,    0.,    5.
 0.0003557, 2282.,    0.,    5.
 9.042e-05,  572.,    1.,    5.
 0.0002394, 1292.,    1.,    5.
 0.0002823, 1652.,    1.,    5.
 0.0003557, 2282.,    1.,    5.
*Material, name=GRAPH70
**** DPA = Fluence (n/m**2) X 8.23e-26 for graphite (Sterbentz
Letter)
**** based on k(irr)=((0.25-
0.00017*T(irr))*A*log(DPA)+0.000683*T(irr))*k(non)
**** A = -1.0, Temp in deg C for correlation
** 7.0% Boron Graphtec
** cond,  temp,  %Ne,  Fluence
*Conductivity, dependencies=2
 0.0007085,  572.,    0.,    0.
 0.0004738, 1292.,    0.,    0.
 0.0003962, 1652.,    0.,    0.
 0.0003359, 2282.,    0.,    0.
 0.0007085,  572.,    1.,    0.
 0.0004738, 1292.,    1.,    0.
 0.0003962, 1652.,    1.,    0.
 0.0003359, 2282.,    1.,    0.
 0.0005801,  572.,    0., 0.001
  0.000418, 1292.,    0., 0.001
  0.000362, 1652.,    0., 0.001
 0.0003257, 2282.,    0., 0.001
 0.0005801,  572.,    1., 0.001
  0.000418, 1292.,    1., 0.001
  0.000362, 1652.,    1., 0.001
 0.0003257, 2282.,    1., 0.001
 0.0004391,  572.,    0.,  0.01
 0.0003559, 1292.,    0.,  0.01
 0.0003236, 1652.,    0.,  0.01
 0.0003131, 2282.,    0.,  0.01
 0.0004391,  572.,    1.,  0.01
 0.0003559, 1292.,    1.,  0.01
 0.0003236, 1652.,    1.,  0.01
 0.0003131, 2282.,    1.,  0.01
 0.0002981,  572.,    0.,   0.1
 0.0002938, 1292.,    0.,   0.1
 0.0002852, 1652.,    0.,   0.1
 0.0003005, 2282.,    0.,   0.1
 0.0002981,  572.,    1.,   0.1
 0.0002938, 1292.,    1.,   0.1
 0.0002852, 1652.,    1.,   0.1
 0.0003005, 2282.,    1.,   0.1
 0.0001571,  572.,    0.,    1.
 0.0002318, 1292.,    0.,    1.
 0.0002468, 1652.,    0.,    1.
 0.0002879, 2282.,    0.,    1.
 0.0001571,  572.,    1.,    1.
 0.0002318, 1292.,    1.,    1.
 0.0002468, 1652.,    1.,    1.
 0.0002879, 2282.,    1.,    1.
 5.853e-05,  572.,    0.,    5.
 0.0001884, 1292.,    0.,    5.
 0.0002199, 1652.,    0.,    5.
 0.0002791, 2282.,    0.,    5.
 5.853e-05,  572.,    1.,    5.
 0.0001884, 1292.,    1.,    5.
 0.0002199, 1652.,    1.,    5.
 0.0002791, 2282.,    1.,    5.
```

```
*Material, name=HAF
*Conductivity
 0.0003079, 80.
 0.0002986,260.
 0.0002847,620.
 0.0002778,980.
*Density
 0.48,
*Specific Heat
 0.035,
*Material, name=HE-NE
*Conductivity, dependencies=1
 2.088e-06,  80.,   0.
 2.976e-06, 440.,   0.
 3.763e-06, 800.,   0.
 4.485e-06,1160.,   0.
  6.11e-06,2060.,   0.
 1.769e-06,  80.,  0.2
 2.485e-06, 440.,  0.2
 3.118e-06, 800.,  0.2
 3.688e-06,1160.,  0.2
 4.966e-06,2060.,  0.2
 1.463e-06,  80.,  0.4
 2.031e-06, 440.,  0.4
 2.533e-06, 800.,  0.4
 2.978e-06,1160.,  0.4
 3.975e-06,2060.,  0.4
 1.176e-06,  80.,  0.6
 1.618e-06, 440.,  0.6
 2.011e-06, 800.,  0.6
 2.351e-06,1160.,  0.6
 3.122e-06,2060.,  0.6
 9.082e-07,  80.,  0.8
 1.245e-06, 440.,  0.8
 1.545e-06, 800.,  0.8
 1.798e-06,1160.,  0.8
 2.385e-06,2060.,  0.8
   6.6e-07,  80.,   1.
 9.077e-07, 440.,   1.
  1.13e-06, 800.,   1.
 1.309e-06,1160.,   1.
 1.744e-06,2060.,   1.
*Density
 2.89e-05,
*Elastic
1000.,0.
*Expansion
 1.35e-08,
*Specific Heat
 0.245,
*Material, name=HE-NER
*Conductivity, dependencies=1
 2.088e-06,  80.,   0.
 2.976e-06, 440.,   0.
 3.763e-06, 800.,   0.
 4.485e-06,1160.,   0.
  6.11e-06,2060.,   0.
 1.769e-06,  80.,  0.2
 2.485e-06, 440.,  0.2
 3.118e-06, 800.,  0.2
 3.688e-06,1160.,  0.2
 4.966e-06,2060.,  0.2
 1.463e-06,  80.,  0.4
 2.031e-06, 440.,  0.4
 2.533e-06, 800.,  0.4
 2.978e-06,1160.,  0.4
 3.975e-06,2060.,  0.4
 1.176e-06,  80.,  0.6
 1.618e-06, 440.,  0.6
 2.011e-06, 800.,  0.6
 2.351e-06,1160.,  0.6
 3.122e-06,2060.,  0.6
 9.082e-07,  80.,  0.8
 1.245e-06, 440.,  0.8
 1.545e-06, 800.,  0.8
 1.798e-06,1160.,  0.8
 2.385e-06,2060.,  0.8
   6.6e-07,  80.,   1.
 9.077e-07, 440.,   1.
  1.13e-06, 800.,   1.
 1.309e-06,1160.,   1.
 1.744e-06,2060.,   1.
*Density
 2.89e-05,
*Elastic
1000.,0.
*Expansion
 1.35e-08,
*Specific Heat
 0.245,
*Material, name=HE-NE_Gas_Control
*Conductivity, dependencies=2
   2.2e-06,  80.,   0.,   0.
```

```
 3.135e-06, 440.,   0.,   0.
 3.964e-06, 800.,   0.,   0.
 4.724e-06,1160.,   0.,   0.
 6.437e-06,2060.,   0.,   0.
 1.864e-06,  80.,  0.2,   0.
 2.618e-06, 440.,  0.2,   0.
 3.284e-06, 800.,  0.2,   0.
 3.886e-06,1160.,  0.2,   0.
 5.231e-06,2060.,  0.2,   0.
 1.542e-06,  80.,  0.4,   0.
 2.139e-06, 440.,  0.4,   0.
 2.669e-06, 800.,  0.4,   0.
 3.137e-06,1160.,  0.4,   0.
 4.188e-06,2060.,  0.4,   0.
 1.239e-06,  80.,  0.6,   0.
 1.705e-06, 440.,  0.6,   0.
 2.118e-06, 800.,  0.6,   0.
 2.476e-06,1160.,  0.6,   0.
 3.289e-06,2060.,  0.6,   0.
 9.567e-07,  80.,  0.8,   0.
 1.311e-06, 440.,  0.8,   0.
 1.628e-06, 800.,  0.8,   0.
 1.894e-06,1160.,  0.8,   0.
 2.512e-06,2060.,  0.8,   0.
 6.953e-07,  80.,   1.,   0.
 9.562e-07, 440.,   1.,   0.
  1.19e-06, 800.,   1.,   0.
 1.379e-06,1160.,   1.,   0.
 1.838e-06,2060.,   1.,   0.
 1.827e-06,  80.,   0., 2.86
 2.604e-06, 440.,   0., 2.86
 3.293e-06, 800.,   0., 2.86
 3.925e-06,1160.,   0., 2.86
 5.347e-06,2060.,   0., 2.86
 1.548e-06,  80.,  0.2, 2.86
 2.175e-06, 440.,  0.2, 2.86
 2.728e-06, 800.,  0.2, 2.86
 3.228e-06,1160.,  0.2, 2.86
 4.346e-06,2060.,  0.2, 2.86
 1.281e-06,  80.,  0.4, 2.86
 1.777e-06, 440.,  0.4, 2.86
 2.217e-06, 800.,  0.4, 2.86
 2.606e-06,1160.,  0.4, 2.86
 3.479e-06,2060.,  0.4, 2.86
 1.029e-06,  80.,  0.6, 2.86
 1.416e-06, 440.,  0.6, 2.86
  1.76e-06, 800.,  0.6, 2.86
 2.057e-06,1160.,  0.6, 2.86
 2.732e-06,2060.,  0.6, 2.86
 7.947e-07,  80.,  0.8, 2.86
 1.089e-06, 440.,  0.8, 2.86
 1.352e-06, 800.,  0.8, 2.86
 1.574e-06,1160.,  0.8, 2.86
 2.087e-06,2060.,  0.8, 2.86
 5.776e-07,  80.,   1., 2.86
 7.943e-07, 440.,   1., 2.86
 9.888e-07, 800.,   1., 2.86
 1.146e-06,1160.,   1., 2.86
 1.527e-06,2060.,   1., 2.86
*Density
 2.89e-05,
*Elastic
1000.,0.
*Expansion
 1.35e-08,
*Specific Heat
 0.245,
*Material, name=HELIUM
*Conductivity
   6.6e-07,  80.
 7.899e-07, 260.
 9.077e-07, 440.
 1.028e-06, 620.
  1.13e-06, 800.
 1.224e-06, 980.
 1.309e-06,1160.
   1.4e-06,1340.
 1.493e-06,1520.
 1.581e-06,1700.
 1.665e-06,1880.
 1.744e-06,2060.
*Density
 2.89e-05,
*Elastic
1000.,0.
*Expansion
 1.35e-08,
*Specific Heat
 0.245,
*Material, name=INSL
*Conductivity
   6.6e-07,  80.
 7.899e-07, 260.
 9.077e-07, 440.
 1.028e-06, 620.
  1.13e-06, 800.
 1.224e-06, 980.
 1.309e-06,1160.
   1.4e-06,1340.
 1.493e-06,1520.
 1.581e-06,1700.
 1.665e-06,1880.
 1.744e-06,2060.
*Density
 0.0404,
*Specific Heat
 0.17,
*Material, name=MIX
*Conductivity
   0.00147,   93.3
  0.000579,  304.4
 0.0004327,   610.
 0.0003462,  826.7
 0.0002596, 1204.4
*Density
 0.00796,
*Elastic
 2.88e+07,0.
*Expansion
  8.89e-06, 100.
  9.56e-06, 600.
 1.094e-05,1000.
*Specific Heat
 0.502,
*Material, name=NIOB
*Conductivity
 0.0006329, 180.
 0.0006824, 451.
 0.0007399, 975.
 0.0007453,1312.
 0.0008804,2098.
*Density
 0.309,
*Expansion
 8.5e-06,
*Specific Heat
 0.063,
*Material, name=SS
*Conductivity
 0.0002069, 100.
 0.0003206,1300.
*Density
 0.286,
*Elastic
 1e+06,0.
*Expansion
  8.85e-06, 212.
 1.148e-05,1112.
*Specific Heat
 0.12,
*Material, name=WATER
*Conductivity
 0.1,
*Density
 0.00112287,
*Expansion
    1e-05, 40.
 0.000328,160.
 0.000694,360.
  0.00236,600.
*Specific Heat
1.,
**
** INTERACTION PROPERTIES
**
*Surface Interaction, name=Compacts-Spacers
1.,
*Gap Radiation
1., 1.
1.,    0.
1.,    1.
0., 1.001
*Surface Interaction, name=CondRad_Graph_Graph
1.,
*Gap Conductance, dependencies=1
 1.671e-05,     0.,    80., ,     0.
 1.671e-05,    0.3,    80., ,     0.
 2.381e-05,     0.,   440., ,     0.
 2.381e-05,    0.3,   440., ,     0.
  3.01e-05,     0.,   800., ,     0.
  3.01e-05,    0.3,   800., ,     0.
 3.588e-05,     0.,  1160., ,     0.
 3.588e-05,    0.3,  1160., ,     0.
 4.888e-05,     0.,  2060., ,     0.
 4.888e-05,    0.3,  2060., ,     0.
 1.416e-05,     0.,    80., ,    0.2
```

```
 1.416e-05,    0.3,    80., ,    0.2
 1.988e-05,     0.,   440., ,    0.2
 1.988e-05,    0.3,   440., ,    0.2
 2.494e-05,     0.,   800., ,    0.2
 2.494e-05,    0.3,   800., ,    0.2
 2.951e-05,     0.,  1160., ,    0.2
 2.951e-05,    0.3,  1160., ,    0.2
 3.973e-05,     0.,  2060., ,    0.2
 3.973e-05,    0.3,  2060., ,    0.2
 1.171e-05,     0.,    80., ,    0.4
 1.171e-05,    0.3,    80., ,    0.4
 1.625e-05,     0.,   440., ,    0.4
 1.625e-05,    0.3,   440., ,    0.4
 2.027e-05,     0.,   800., ,    0.4
 2.027e-05,    0.3,   800., ,    0.4
 2.382e-05,     0.,  1160., ,    0.4
 2.382e-05,    0.3,  1160., ,    0.4
  3.18e-05,     0.,  2060., ,    0.4
  3.18e-05,    0.3,  2060., ,    0.4
 9.407e-06,     0.,    80., ,    0.6
 9.407e-06,    0.3,    80., ,    0.6
 1.294e-05,     0.,   440., ,    0.6
 1.294e-05,    0.3,   440., ,    0.6
 1.609e-05,     0.,   800., ,    0.6
 1.609e-05,    0.3,   800., ,    0.6
 1.881e-05,     0.,  1160., ,    0.6
 1.881e-05,    0.3,  1160., ,    0.6
 2.498e-05,     0.,  2060., ,    0.6
 2.498e-05,    0.3,  2060., ,    0.6
 7.265e-06,     0.,    80., ,    0.8
 7.265e-06,    0.3,    80., ,    0.8
 9.959e-06,     0.,   440., ,    0.8
 9.959e-06,    0.3,   440., ,    0.8
 1.236e-05,     0.,   800., ,    0.8
 1.236e-05,    0.3,   800., ,    0.8
 1.438e-05,     0.,  1160., ,    0.8
 1.438e-05,    0.3,  1160., ,    0.8
 1.908e-05,     0.,  2060., ,    0.8
 1.908e-05,    0.3,  2060., ,    0.8
  5.28e-06,     0.,    80., ,     1.
  5.28e-06,    0.3,    80., ,     1.
 7.262e-06,     0.,   440., ,     1.
 7.262e-06,    0.3,   440., ,     1.
  9.04e-06,     0.,   800., ,     1.
  9.04e-06,    0.3,   800., ,     1.
 1.047e-05,     0.,  1160., ,     1.
 1.047e-05,    0.3,  1160., ,     1.
 1.396e-05,     0.,  2060., ,     1.
 1.396e-05,    0.3,  2060., ,     1.
        0., 0.3003,  2060., ,     1.
*Gap Radiation
1., 1.
1.,    0.
1.,    1.
0., 1.001
*Surface Interaction, name=CondRad_Graph_SS
1.,
*Gap Conductance, dependencies=1
 5.495e-05,     0.,    80., ,     0.
 5.495e-05,    0.3,    80., ,     0.
 7.832e-05,     0.,   440., ,     0.
 7.832e-05,    0.3,   440., ,     0.
 9.902e-05,     0.,   800., ,     0.
 9.902e-05,    0.3,   800., ,     0.
  0.000118,     0.,  1160., ,     0.
  0.000118,    0.3,  1160., ,     0.
 0.0001608,     0.,  2060., ,     0.
 0.0001608,    0.3,  2060., ,     0.
 4.656e-05,     0.,    80., ,    0.2
 4.656e-05,    0.3,    80., ,    0.2
 6.539e-05,     0.,   440., ,    0.2
 6.539e-05,    0.3,   440., ,    0.2
 8.205e-05,     0.,   800., ,    0.2
 8.205e-05,    0.3,   800., ,    0.2
 9.706e-05,     0.,  1160., ,    0.2
 9.706e-05,    0.3,  1160., ,    0.2
 0.0001307,     0.,  2060., ,    0.2
 0.0001307,    0.3,  2060., ,    0.2
 3.851e-05,     0.,    80., ,    0.4
 3.851e-05,    0.3,    80., ,    0.4
 5.344e-05,     0.,   440., ,    0.4
 5.344e-05,    0.3,   440., ,    0.4
 6.667e-05,     0.,   800., ,    0.4
 6.667e-05,    0.3,   800., ,    0.4
 7.837e-05,     0.,  1160., ,    0.4
 7.837e-05,    0.3,  1160., ,    0.4
 0.0001046,     0.,  2060., ,    0.4
 0.0001046,    0.3,  2060., ,    0.4
 3.094e-05,     0.,    80., ,    0.6
 3.094e-05,    0.3,    80., ,    0.6
 4.258e-05,     0.,   440., ,    0.6
 4.258e-05,    0.3,   440., ,    0.6
 5.292e-05,     0.,   800., ,    0.6
 5.292e-05,    0.3,   800., ,    0.6
 6.187e-05,     0.,  1160., ,    0.6
 6.187e-05,    0.3,  1160., ,    0.6
 8.216e-05,     0.,  2060., ,    0.6
 8.216e-05,    0.3,  2060., ,    0.6
  2.39e-05,     0.,    80., ,    0.8
  2.39e-05,    0.3,    80., ,    0.8
 3.276e-05,     0.,   440., ,    0.8
 3.276e-05,    0.3,   440., ,    0.8
 4.067e-05,     0.,   800., ,    0.8
 4.067e-05,    0.3,   800., ,    0.8
 4.732e-05,     0.,  1160., ,    0.8
 4.732e-05,    0.3,  1160., ,    0.8
 6.276e-05,     0.,  2060., ,    0.8
 6.276e-05,    0.3,  2060., ,    0.8
 1.737e-05,     0.,    80., ,     1.
 1.737e-05,    0.3,    80., ,     1.
 2.389e-05,     0.,   440., ,     1.
 2.389e-05,    0.3,   440., ,     1.
 2.974e-05,     0.,   800., ,     1.
 2.974e-05,    0.3,   800., ,     1.
 3.446e-05,     0.,  1160., ,     1.
 3.446e-05,    0.3,  1160., ,     1.
 4.591e-05,     0.,  2060., ,     1.
 4.591e-05,    0.3,  2060., ,     1.
        0., 0.3003,  2060., ,     1.
*Gap Radiation
1., 1.
1.,    0.
1.,    1.
0., 1.001
*Surface Interaction, name=Graphrad_Ssrad
1.,
*Gap Radiation
1., 1.
1.,    0.
1.,    1.
0., 1.001
*Surface Interaction, name=Graphrad_Tuberad
1.,
*Gap Radiation
1., 1.
1.,    0.
1.,    1.
0., 1.001
*Surface Interaction, name=INT1
1.,
*Gap Conductance
 0.00694,     0.,     0.
 0.00694,    0.3,     0.
 0.00694,     0.,  2000.
 0.00694,    0.3,  2000.
*Surface Interaction, name=INT2
1.,
*Gap Conductance
 0.03,     0.,     0.
 0.03,    0.3,     0.
 0.03,     0.,   158.
 0.03,    0.3,   158.
 0.03,     0.,   968.
 0.03,    0.3,   968.
 0.03,     0.,  2000.
 0.03,    0.3,  2000.
*Surface Interaction, name=INT3
1.,
*Gap Conductance
 0.028,     0.,     0.
 0.028,    0.3,     0.
 0.028,     0.,   158.
 0.028,    0.3,   158.
 0.028,     0.,   968.
 0.028,    0.3,   968.
 0.028,     0.,  2000.
 0.028,    0.3,  2000.
*Surface Interaction, name=INT4
1.,
*Gap Conductance, dependencies=2
 0.0008353,     0.,    80., ,     0.,     0.
 0.0008353,    0.3,    80., ,     0.,     0.
 0.0011905,     0.,   440., ,     0.,     0.
 0.0011905,    0.3,   440., ,     0.,     0.
 0.0015051,     0.,   800., ,     0.,     0.
 0.0015051,    0.3,   800., ,     0.,     0.
 0.0017939,     0.,  1160., ,     0.,     0.
 0.0017939,    0.3,  1160., ,     0.,     0.
 0.0024441,     0.,  2060., ,     0.,     0.
 0.0024441,    0.3,  2060., ,     0.,     0.
 0.0007078,     0.,    80., ,    0.2,     0.
 0.0007078,    0.3,    80., ,    0.2,     0.
  0.000994,     0.,   440., ,    0.2,     0.
  0.000994,    0.3,   440., ,    0.2,     0.
 0.0012471,     0.,   800., ,    0.2,     0.
 0.0012471,    0.3,   800., ,    0.2,     0.
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0.0014754,    0.,  1160., ,    0.2,     0.
0.0014754,   0.3,  1160., ,    0.2,     0.
0.0019864,    0.,  2060., ,    0.2,     0.
0.0019864,   0.3,  2060., ,    0.2,     0.
0.0005854,    0.,    80., ,    0.4,     0.
0.0005854,   0.3,    80., ,    0.4,     0.
0.0008124,    0.,   440., ,    0.4,     0.
0.0008124,   0.3,   440., ,    0.4,     0.
0.0010133,    0.,   800., ,    0.4,     0.
0.0010133,   0.3,   800., ,    0.4,     0.
0.0011912,    0.,  1160., ,    0.4,     0.
0.0011912,   0.3,  1160., ,    0.4,     0.
0.0015901,    0.,  2060., ,    0.4,     0.
0.0015901,   0.3,  2060., ,    0.4,     0.
0.0004703,    0.,    80., ,    0.6,     0.
0.0004703,   0.3,    80., ,    0.6,     0.
0.0006472,    0.,   440., ,    0.6,     0.
0.0006472,   0.3,   440., ,    0.6,     0.
0.0008043,    0.,   800., ,    0.6,     0.
0.0008043,   0.3,   800., ,    0.6,     0.
0.0009404,    0.,  1160., ,    0.6,     0.
0.0009404,   0.3,  1160., ,    0.6,     0.
0.0012488,    0.,  2060., ,    0.6,     0.
0.0012488,   0.3,  2060., ,    0.6,     0.
0.0003633,    0.,    80., ,    0.8,     0.
0.0003633,   0.3,    80., ,    0.8,     0.
0.0004979,    0.,   440., ,    0.8,     0.
0.0004979,   0.3,   440., ,    0.8,     0.
0.0006181,    0.,   800., ,    0.8,     0.
0.0006181,   0.3,   800., ,    0.8,     0.
0.0007192,    0.,  1160., ,    0.8,     0.
0.0007192,   0.3,  1160., ,    0.8,     0.
 0.000954,    0.,  2060., ,    0.8,     0.
 0.000954,   0.3,  2060., ,    0.8,     0.
 0.000264,    0.,    80., ,     1.,     0.
 0.000264,   0.3,    80., ,     1.,     0.
0.0003631,    0.,   440., ,     1.,     0.
0.0003631,   0.3,   440., ,     1.,     0.
 0.000452,    0.,   800., ,     1.,     0.
 0.000452,   0.3,   800., ,     1.,     0.
0.0005237,    0.,  1160., ,     1.,     0.
0.0005237,   0.3,  1160., ,     1.,     0.
0.0006978,    0.,  2060., ,     1.,     0.
0.0006978,   0.3,  2060., ,     1.,     0.
0.0005985,    0.,    80., ,     0.,  2.86
0.0005985,   0.3,    80., ,     0.,  2.86
 0.000853,    0.,   440., ,     0.,  2.86
 0.000853,   0.3,   440., ,     0.,  2.86
0.0010784,    0.,   800., ,     0.,  2.86
0.0010784,   0.3,   800., ,     0.,  2.86
0.0012854,    0.,  1160., ,     0.,  2.86
0.0012854,   0.3,  1160., ,     0.,  2.86
0.0017512,    0.,  2060., ,     0.,  2.86
0.0017512,   0.3,  2060., ,     0.,  2.86
0.0005071,    0.,    80., ,    0.2,  2.86
0.0005071,   0.3,    80., ,    0.2,  2.86
0.0007122,    0.,   440., ,    0.2,  2.86
0.0007122,   0.3,   440., ,    0.2,  2.86
0.0008936,    0.,   800., ,    0.2,  2.86
0.0008936,   0.3,   800., ,    0.2,  2.86
0.0010571,    0.,  1160., ,    0.2,  2.86
0.0010571,   0.3,  1160., ,    0.2,  2.86
0.0014233,    0.,  2060., ,    0.2,  2.86
0.0014233,   0.3,  2060., ,    0.2,  2.86
0.0004194,    0.,    80., ,    0.4,  2.86
0.0004194,   0.3,    80., ,    0.4,  2.86
0.0005821,    0.,   440., ,    0.4,  2.86
0.0005821,   0.3,   440., ,    0.4,  2.86
0.0007261,    0.,   800., ,    0.4,  2.86
0.0007261,   0.3,   800., ,    0.4,  2.86
0.0008535,    0.,  1160., ,    0.4,  2.86
0.0008535,   0.3,  1160., ,    0.4,  2.86
0.0011393,    0.,  2060., ,    0.4,  2.86
0.0011393,   0.3,  2060., ,    0.4,  2.86
 0.000337,    0.,    80., ,    0.6,  2.86
 0.000337,   0.3,    80., ,    0.6,  2.86
0.0004637,    0.,   440., ,    0.6,  2.86
0.0004637,   0.3,   440., ,    0.6,  2.86
0.0005763,    0.,   800., ,    0.6,  2.86
0.0005763,   0.3,   800., ,    0.6,  2.86
0.0006738,    0.,  1160., ,    0.6,  2.86
0.0006738,   0.3,  1160., ,    0.6,  2.86
0.0008948,    0.,  2060., ,    0.6,  2.86
0.0008948,   0.3,  2060., ,    0.6,  2.86
0.0002603,    0.,    80., ,    0.8,  2.86
0.0002603,   0.3,    80., ,    0.8,  2.86
0.0003568,    0.,   440., ,    0.8,  2.86
0.0003568,   0.3,   440., ,    0.8,  2.86
0.0004429,    0.,   800., ,    0.8,  2.86
0.0004429,   0.3,   800., ,    0.8,  2.86
0.0005153,    0.,  1160., ,    0.8,  2.86
0.0005153,   0.3,  1160., ,    0.8,  2.86
0.0006835,    0.,  2060., ,    0.8,  2.86
0.0006835,   0.3,  2060., ,    0.8,  2.86
0.0001892,    0.,    80., ,     1.,  2.86
0.0001892,   0.3,    80., ,     1.,  2.86
0.0002601,    0.,   440., ,     1.,  2.86
0.0002601,   0.3,   440., ,     1.,  2.86
0.0003238,    0.,   800., ,     1.,  2.86
0.0003238,   0.3,   800., ,     1.,  2.86
0.0003753,    0.,  1160., ,     1.,  2.86
0.0003753,   0.3,  1160., ,     1.,  2.86
   0.0005,    0.,  2060., ,     1.,  2.86
   0.0005,   0.3,  2060., ,     1.,  2.86
0.0004288, 0.3003, 2060., ,     1.,  2.86
*Surface Interaction, name=Ssrad_Tuberad
1.,
*Gap Radiation
1., 1.
1.,    0.
1.,    1.
0., 1.001
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Capsule 2 Control Gas Gap

```
*Material, name=HE-NE_Control_Gas
*Conductivity, dependencies=3
 2.287e-06,  80.,   0.,   0.,   0.
 3.259e-06, 440.,   0.,   0.,   0.
 4.121e-06, 800.,   0.,   0.,   0.
 4.912e-06,1160.,   0.,   0.,   0.
 6.691e-06,2060.,   0.,   0.,   0.
 1.938e-06,  80.,  0.2,   0.,   0.
 2.721e-06, 440.,  0.2,   0.,   0.
 3.414e-06, 800.,  0.2,   0.,   0.
 4.039e-06,1160.,  0.2,   0.,   0.
 5.439e-06,2060.,  0.2,   0.,   0.
 1.603e-06,  80.,  0.4,   0.,   0.
 2.224e-06, 440.,  0.4,   0.,   0.
 2.774e-06, 800.,  0.4,   0.,   0.
 3.261e-06,1160.,  0.4,   0.,   0.
 4.353e-06,2060.,  0.4,   0.,   0.
 1.288e-06,  80.,  0.6,   0.,   0.
 1.772e-06, 440.,  0.6,   0.,   0.
 2.202e-06, 800.,  0.6,   0.,   0.
 2.575e-06,1160.,  0.6,   0.,   0.
 3.419e-06,2060.,  0.6,   0.,   0.
 9.946e-07,  80.,  0.8,   0.,   0.
 1.363e-06, 440.,  0.8,   0.,   0.
 1.692e-06, 800.,  0.8,   0.,   0.
 1.969e-06,1160.,  0.8,   0.,   0.
 2.612e-06,2060.,  0.8,   0.,   0.
 7.228e-07,  80.,   1.,   0.,   0.
 9.941e-07, 440.,   1.,   0.,   0.
 1.237e-06, 800.,   1.,   0.,   0.
 1.434e-06,1160.,   1.,   0.,   0.
  1.91e-06,2060.,   1.,   0.,   0.
 1.248e-05,  80.,   0., 3.54,   0.
 1.779e-05, 440.,   0., 3.54,   0.
 2.249e-05, 800.,   0., 3.54,   0.
 2.681e-05,1160.,   0., 3.54,   0.
 3.652e-05,2060.,   0., 3.54,   0.
 1.058e-05,  80.,  0.2, 3.54,   0.
 1.485e-05, 440.,  0.2, 3.54,   0.
 1.864e-05, 800.,  0.2, 3.54,   0.
 2.205e-05,1160.,  0.2, 3.54,   0.
 2.968e-05,2060.,  0.2, 3.54,   0.
 8.748e-06,  80.,  0.4, 3.54,   0.
 1.214e-05, 440.,  0.4, 3.54,   0.
 1.514e-05, 800.,  0.4, 3.54,   0.
  1.78e-05,1160.,  0.4, 3.54,   0.
 2.376e-05,2060.,  0.4, 3.54,   0.
 7.029e-06,  80.,  0.6, 3.54,   0.
 9.672e-06, 440.,  0.6, 3.54,   0.
 1.202e-05, 800.,  0.6, 3.54,   0.
 1.405e-05,1160.,  0.6, 3.54,   0.
 1.866e-05,2060.,  0.6, 3.54,   0.
 5.429e-06,  80.,  0.8, 3.54,   0.
 7.441e-06, 440.,  0.8, 3.54,   0.
 9.237e-06, 800.,  0.8, 3.54,   0.
 1.075e-05,1160.,  0.8, 3.54,   0.
 1.426e-05,2060.,  0.8, 3.54,   0.
 3.945e-06,  80.,   1., 3.54,   0.
 5.426e-06, 440.,   1., 3.54,   0.
 6.754e-06, 800.,   1., 3.54,   0.
 7.827e-06,1160.,   1., 3.54,   0.
 1.043e-05,2060.,   1., 3.54,   0.
 2.287e-06,  80.,   0.,   0., 0.33
 3.259e-06, 440.,   0.,   0., 0.33
 4.121e-06, 800.,   0.,   0., 0.33
 4.912e-06,1160.,   0.,   0., 0.33
 6.691e-06,2060.,   0.,   0., 0.33
 1.938e-06,  80.,  0.2,   0., 0.33
 2.721e-06, 440.,  0.2,   0., 0.33
 3.414e-06, 800.,  0.2,   0., 0.33
 4.039e-06,1160.,  0.2,   0., 0.33
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1.603e-06,  80.,  0.4,   0., 0.33
2.224e-06, 440.,  0.4,   0., 0.33
2.774e-06, 800.,  0.4,   0., 0.33
3.261e-06,1160.,  0.4,   0., 0.33
4.353e-06,2060.,  0.4,   0., 0.33
1.288e-06,  80.,  0.6,   0., 0.33
1.772e-06, 440.,  0.6,   0., 0.33
2.202e-06, 800.,  0.6,   0., 0.33
2.575e-06,1160.,  0.6,   0., 0.33
3.419e-06,2060.,  0.6,   0., 0.33
9.946e-07,  80.,  0.8,   0., 0.33
1.363e-06, 440.,  0.8,   0., 0.33
1.692e-06, 800.,  0.8,   0., 0.33
1.969e-06,1160.,  0.8,   0., 0.33
2.612e-06,2060.,  0.8,   0., 0.33
7.228e-07,  80.,   1.,   0., 0.33
9.941e-07, 440.,   1.,   0., 0.33
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1.692e-06, 800.,  0.8,   0.,   1.
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2.612e-06,2060.,  0.8,   0.,   1.
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9.941e-07, 440.,   1.,   0.,   1.
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 5.17e-06, 440.,   0., 3.54,   1.
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1.772e-06, 440.,  0.6,   0., 1.67
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1.692e-06, 800.,  0.8,   0., 1.67
1.969e-06,1160.,  0.8,   0., 1.67
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1.969e-06,1160.,  0.8,   0.,   3.
2.612e-06,2060.,  0.8,   0.,   3.
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2.774e-06, 800.,  0.4,   0., 3.67
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4.353e-06,2060.,  0.4,   0., 3.67
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1.413e-05, 800.,  0.6, 3.54, 3.67
1.652e-05,1160.,  0.6, 3.54, 3.67
2.194e-05,2060.,  0.6, 3.54, 3.67
6.382e-06,  80.,  0.8, 3.54, 3.67
8.748e-06, 440.,  0.8, 3.54, 3.67
1.086e-05, 800.,  0.8, 3.54, 3.67
1.264e-05,1160.,  0.8, 3.54, 3.67
1.676e-05,2060.,  0.8, 3.54, 3.67
4.639e-06,  80.,   1., 3.54, 3.67
6.379e-06, 440.,   1., 3.54, 3.67
7.941e-06, 800.,   1., 3.54, 3.67
9.202e-06,1160.,   1., 3.54, 3.67
1.226e-05,2060.,   1., 3.54, 3.67
2.287e-06,  80.,   0.,   0.,   4.
3.259e-06, 440.,   0.,   0.,   4.
4.121e-06, 800.,   0.,   0.,   4.
4.912e-06,1160.,   0.,   0.,   4.
6.691e-06,2060.,   0.,   0.,   4.
1.938e-06,  80.,  0.2,   0.,   4.
2.721e-06, 440.,  0.2,   0.,   4.
3.414e-06, 800.,  0.2,   0.,   4.
4.039e-06,1160.,  0.2,   0.,   4.
5.439e-06,2060.,  0.2,   0.,   4.
1.603e-06,  80.,  0.4,   0.,   4.
2.224e-06, 440.,  0.4,   0.,   4.
2.774e-06, 800.,  0.4,   0.,   4.
3.261e-06,1160.,  0.4,   0.,   4.
4.353e-06,2060.,  0.4,   0.,   4.
1.288e-06,  80.,  0.6,   0.,   4.
1.772e-06, 440.,  0.6,   0.,   4.
2.202e-06, 800.,  0.6,   0.,   4.
2.575e-06,1160.,  0.6,   0.,   4.
3.419e-06,2060.,  0.6,   0.,   4.
9.946e-07,  80.,  0.8,   0.,   4.
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1.363e-06, 440., 0.8,   0.,   4.
1.692e-06, 800., 0.8,   0.,   4.
1.969e-06,1160., 0.8,   0.,   4.
2.612e-06,2060., 0.8,   0.,   4.
7.228e-07,  80.,  1.,   0.,   4.
9.941e-07, 440.,  1.,   0.,   4.
1.237e-06, 800.,  1.,   0.,   4.
1.434e-06,1160.,  1.,   0.,   4.
 1.91e-06,2060.,  1.,   0.,   4.
1.467e-05,  80.,  0., 3.54,   4.
2.092e-05, 440.,  0., 3.54,   4.
2.644e-05, 800.,  0., 3.54,   4.
3.152e-05,1160.,  0., 3.54,   4.
4.294e-05,2060.,  0., 3.54,   4.
1.243e-05,  80., 0.2, 3.54,   4.
1.746e-05, 440., 0.2, 3.54,   4.
2.191e-05, 800., 0.2, 3.54,   4.
2.592e-05,1160., 0.2, 3.54,   4.
 3.49e-05,2060., 0.2, 3.54,   4.
1.028e-05,  80., 0.4, 3.54,   4.
1.427e-05, 440., 0.4, 3.54,   4.
 1.78e-05, 800., 0.4, 3.54,   4.
2.093e-05,1160., 0.4, 3.54,   4.
2.794e-05,2060., 0.4, 3.54,   4.
8.264e-06,  80., 0.6, 3.54,   4.
1.137e-05, 440., 0.6, 3.54,   4.
1.413e-05, 800., 0.6, 3.54,   4.
1.652e-05,1160., 0.6, 3.54,   4.
2.194e-05,2060., 0.6, 3.54,   4.
6.382e-06,  80., 0.8, 3.54,   4.
8.748e-06, 440., 0.8, 3.54,   4.
1.086e-05, 800., 0.8, 3.54,   4.
1.264e-05,1160., 0.8, 3.54,   4.
1.676e-05,2060., 0.8, 3.54,   4.
4.639e-06,  80.,  1., 3.54,   4.
6.379e-06, 440.,  1., 3.54,   4.
7.941e-06, 800.,  1., 3.54,   4.
9.202e-06,1160.,  1., 3.54,   4.
1.226e-05,2060.,  1., 3.54,   4.
```

Capsule 2 Compact – Graphite Holder Gap

```
*Gap Conductance, dependencies=2
 0.0008353,    0.,    80., ,     0.,     0.
 0.0008353,   0.3,    80., ,     0.,     0.
 0.0011905,    0.,   440., ,     0.,     0.
 0.0011905,   0.3,   440., ,     0.,     0.
 0.0015051,    0.,   800., ,     0.,     0.
 0.0015051,   0.3,   800., ,     0.,     0.
 0.0017939,    0.,  1160., ,     0.,     0.
 0.0017939,   0.3,  1160., ,     0.,     0.
 0.0024441,    0.,  2060., ,     0.,     0.
 0.0024441,   0.3,  2060., ,     0.,     0.
 0.0007078,    0.,    80., ,    0.2,     0.
 0.0007078,   0.3,    80., ,    0.2,     0.
  0.000994,    0.,   440., ,    0.2,     0.
  0.000994,   0.3,   440., ,    0.2,     0.
 0.0012471,    0.,   800., ,    0.2,     0.
 0.0012471,   0.3,   800., ,    0.2,     0.
 0.0014754,    0.,  1160., ,    0.2,     0.
 0.0014754,   0.3,  1160., ,    0.2,     0.
 0.0019864,    0.,  2060., ,    0.2,     0.
 0.0019864,   0.3,  2060., ,    0.2,     0.
 0.0005854,    0.,    80., ,    0.4,     0.
 0.0005854,   0.3,    80., ,    0.4,     0.
 0.0008124,    0.,   440., ,    0.4,     0.
 0.0008124,   0.3,   440., ,    0.4,     0.
 0.0010133,    0.,   800., ,    0.4,     0.
 0.0010133,   0.3,   800., ,    0.4,     0.
 0.0011912,    0.,  1160., ,    0.4,     0.
 0.0011912,   0.3,  1160., ,    0.4,     0.
 0.0015901,    0.,  2060., ,    0.4,     0.
 0.0015901,   0.3,  2060., ,    0.4,     0.
 0.0004703,    0.,    80., ,    0.6,     0.
 0.0004703,   0.3,    80., ,    0.6,     0.
 0.0006472,    0.,   440., ,    0.6,     0.
 0.0006472,   0.3,   440., ,    0.6,     0.
 0.0008043,    0.,   800., ,    0.6,     0.
 0.0008043,   0.3,   800., ,    0.6,     0.
 0.0009404,    0.,  1160., ,    0.6,     0.
 0.0009404,   0.3,  1160., ,    0.6,     0.
 0.0012488,    0.,  2060., ,    0.6,     0.
 0.0012488,   0.3,  2060., ,    0.6,     0.
 0.0003633,    0.,    80., ,    0.8,     0.
 0.0003633,   0.3,    80., ,    0.8,     0.
 0.0004979,    0.,   440., ,    0.8,     0.
 0.0004979,   0.3,   440., ,    0.8,     0.
 0.0006181,    0.,   800., ,    0.8,     0.
 0.0006181,   0.3,   800., ,    0.8,     0.
 0.0007192,    0.,  1160., ,    0.8,     0.
 0.0007192,   0.3,  1160., ,    0.8,     0.
  0.000954,    0.,  2060., ,    0.8,     0.
  0.000954,   0.3,  2060., ,    0.8,     0.
  0.000264,    0.,    80., ,     1.,     0.
  0.000264,   0.3,    80., ,     1.,     0.
 0.0003631,    0.,   440., ,     1.,     0.
 0.0003631,   0.3,   440., ,     1.,     0.
  0.000452,    0.,   800., ,     1.,     0.
  0.000452,   0.3,   800., ,     1.,     0.
 0.0005237,    0.,  1160., ,     1.,     0.
 0.0005237,   0.3,  1160., ,     1.,     0.
 0.0006978,    0.,  2060., ,     1.,     0.
 0.0006978,   0.3,  2060., ,     1.,     0.
 0.0003381,    0.,    80., ,     0.,  3.54
 0.0003381,   0.3,    80., ,     0.,  3.54
 0.0004819,    0.,   440., ,     0.,  3.54
 0.0004819,   0.3,   440., ,     0.,  3.54
 0.0006093,    0.,   800., ,     0.,  3.54
 0.0006093,   0.3,   800., ,     0.,  3.54
 0.0007262,    0.,  1160., ,     0.,  3.54
 0.0007262,   0.3,  1160., ,     0.,  3.54
 0.0009894,    0.,  2060., ,     0.,  3.54
 0.0009894,   0.3,  2060., ,     0.,  3.54
 0.0002865,    0.,    80., ,    0.2,  3.54
 0.0002865,   0.3,    80., ,    0.2,  3.54
 0.0004024,    0.,   440., ,    0.2,  3.54
 0.0004024,   0.3,   440., ,    0.2,  3.54
 0.0005049,    0.,   800., ,    0.2,  3.54
 0.0005049,   0.3,   800., ,    0.2,  3.54
 0.0005973,    0.,  1160., ,    0.2,  3.54
 0.0005973,   0.3,  1160., ,    0.2,  3.54
 0.0008042,    0.,  2060., ,    0.2,  3.54
 0.0008042,   0.3,  2060., ,    0.2,  3.54
  0.000237,    0.,    80., ,    0.4,  3.54
  0.000237,   0.3,    80., ,    0.4,  3.54
 0.0003289,    0.,   440., ,    0.4,  3.54
 0.0003289,   0.3,   440., ,    0.4,  3.54
 0.0004102,    0.,   800., ,    0.4,  3.54
 0.0004102,   0.3,   800., ,    0.4,  3.54
 0.0004822,    0.,  1160., ,    0.4,  3.54
 0.0004822,   0.3,  1160., ,    0.4,  3.54
 0.0006437,    0.,  2060., ,    0.4,  3.54
 0.0006437,   0.3,  2060., ,    0.4,  3.54
 0.0001904,    0.,    80., ,    0.6,  3.54
 0.0001904,   0.3,    80., ,    0.6,  3.54
  0.000262,    0.,   440., ,    0.6,  3.54
  0.000262,   0.3,   440., ,    0.6,  3.54
 0.0003256,    0.,   800., ,    0.6,  3.54
 0.0003256,   0.3,   800., ,    0.6,  3.54
 0.0003807,    0.,  1160., ,    0.6,  3.54
 0.0003807,   0.3,  1160., ,    0.6,  3.54
 0.0005056,    0.,  2060., ,    0.6,  3.54
 0.0005056,   0.3,  2060., ,    0.6,  3.54
 0.0001471,    0.,    80., ,    0.8,  3.54
 0.0001471,   0.3,    80., ,    0.8,  3.54
 0.0002016,    0.,   440., ,    0.8,  3.54
 0.0002016,   0.3,   440., ,    0.8,  3.54
 0.0002502,    0.,   800., ,    0.8,  3.54
 0.0002502,   0.3,   800., ,    0.8,  3.54
 0.0002912,    0.,  1160., ,    0.8,  3.54
 0.0002912,   0.3,  1160., ,    0.8,  3.54
 0.0003862,    0.,  2060., ,    0.8,  3.54
 0.0003862,   0.3,  2060., ,    0.8,  3.54
 0.0001069,    0.,    80., ,     1.,  3.54
 0.0001069,   0.3,    80., ,     1.,  3.54
  0.000147,    0.,   440., ,     1.,  3.54
  0.000147,   0.3,   440., ,     1.,  3.54
  0.000183,    0.,   800., ,     1.,  3.54
  0.000183,   0.3,   800., ,     1.,  3.54
  0.000212,    0.,  1160., ,     1.,  3.54
  0.000212,   0.3,  1160., ,     1.,  3.54
 0.0002825,    0.,  2060., ,     1.,  3.54
 0.0002825,   0.3,  2060., ,     1.,  3.54
 0.0001369, 0.3003,  2060., ,    1.,  3.54
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Capsule 3 Control Gas Gap

```
*Material, name=HE-NE_Gas_Control
*Conductivity, dependencies=2
2.236e-06,  80.,   0.,   0.
3.187e-06, 440.,   0.,   0.
4.029e-06, 800.,   0.,   0.
4.803e-06,1160.,   0.,   0.
6.543e-06,2060.,   0.,   0.
1.895e-06,  80.,  0.2,   0.
2.661e-06, 440.,  0.2,   0.
3.339e-06, 800.,  0.2,   0.
 3.95e-06,1160.,  0.2,   0.
5.318e-06,2060.,  0.2,   0.
1.567e-06,  80.,  0.4,   0.
2.175e-06, 440.,  0.4,   0.
2.713e-06, 800.,  0.4,   0.
3.189e-06,1160.,  0.4,   0.
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4.257e-06,2060.,  0.4,   0.
1.259e-06,  80.,  0.6,   0.
1.733e-06, 440.,  0.6,   0.
2.153e-06, 800.,  0.6,   0.
2.518e-06,1160.,  0.6,   0.
3.343e-06,2060.,  0.6,   0.
9.725e-07,  80.,  0.8,   0.
1.333e-06, 440.,  0.8,   0.
1.655e-06, 800.,  0.8,   0.
1.926e-06,1160.,  0.8,   0.
2.554e-06,2060.,  0.8,   0.
7.068e-07,  80.,   1.,   0.
 9.72e-07, 440.,   1.,   0.
 1.21e-06, 800.,   1.,   0.
1.402e-06,1160.,   1.,   0.
1.868e-06,2060.,   1.,   0.
4.472e-06,  80.,   0., 3.82
6.374e-06, 440.,   0., 3.82
8.059e-06, 800.,   0., 3.82
9.605e-06,1160.,   0., 3.82
1.309e-05,2060.,   0., 3.82
 3.79e-06,  80.,  0.2, 3.82
5.322e-06, 440.,  0.2, 3.82
6.678e-06, 800.,  0.2, 3.82
  7.9e-06,1160.,  0.2, 3.82
1.064e-05,2060.,  0.2, 3.82
3.134e-06,  80.,  0.4, 3.82
 4.35e-06, 440.,  0.4, 3.82
5.426e-06, 800.,  0.4, 3.82
6.378e-06,1160.,  0.4, 3.82
8.514e-06,2060.,  0.4, 3.82
2.518e-06,  80.,  0.6, 3.82
3.466e-06, 440.,  0.6, 3.82
4.307e-06, 800.,  0.6, 3.82
5.035e-06,1160.,  0.6, 3.82
6.687e-06,2060.,  0.6, 3.82
1.945e-06,  80.,  0.8, 3.82
2.666e-06, 440.,  0.8, 3.82
 3.31e-06, 800.,  0.8, 3.82
3.851e-06,1160.,  0.8, 3.82
5.108e-06,2060.,  0.8, 3.82
1.414e-06,  80.,   1., 3.82
1.944e-06, 440.,   1., 3.82
 2.42e-06, 800.,   1., 3.82
2.804e-06,1160.,   1., 3.82
3.736e-06,2060.,   1., 3.82
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Capsule 3 Compact – Graphite Holder Gap

```
*Gap Conductance, dependencies=2
 0.0008353,     0.,    80., ,     0.,     0.
 0.0008353,    0.3,    80., ,     0.,     0.
 0.0011905,     0.,   440., ,     0.,     0.
 0.0011905,    0.3,   440., ,     0.,     0.
 0.0015051,     0.,   800., ,     0.,     0.
 0.0015051,    0.3,   800., ,     0.,     0.
 0.0017939,     0.,  1160., ,     0.,     0.
 0.0017939,    0.3,  1160., ,     0.,     0.
 0.0024441,     0.,  2060., ,     0.,     0.
 0.0024441,    0.3,  2060., ,     0.,     0.
 0.0007078,     0.,    80., ,    0.2,     0.
 0.0007078,    0.3,    80., ,    0.2,     0.
  0.000994,     0.,   440., ,    0.2,     0.
  0.000994,    0.3,   440., ,    0.2,     0.
 0.0012471,     0.,   800., ,    0.2,     0.
 0.0012471,    0.3,   800., ,    0.2,     0.
 0.0014754,     0.,  1160., ,    0.2,     0.
 0.0014754,    0.3,  1160., ,    0.2,     0.
 0.0019864,     0.,  2060., ,    0.2,     0.
 0.0019864,    0.3,  2060., ,    0.2,     0.
 0.0005854,     0.,    80., ,    0.4,     0.
 0.0005854,    0.3,    80., ,    0.4,     0.
 0.0008124,     0.,   440., ,    0.4,     0.
 0.0008124,    0.3,   440., ,    0.4,     0.
 0.0010133,     0.,   800., ,    0.4,     0.
 0.0010133,    0.3,   800., ,    0.4,     0.
 0.0011912,     0.,  1160., ,    0.4,     0.
 0.0011912,    0.3,  1160., ,    0.4,     0.
 0.0015901,     0.,  2060., ,    0.4,     0.
 0.0015901,    0.3,  2060., ,    0.4,     0.
 0.0004703,     0.,    80., ,    0.6,     0.
 0.0004703,    0.3,    80., ,    0.6,     0.
 0.0006472,     0.,   440., ,    0.6,     0.
 0.0006472,    0.3,   440., ,    0.6,     0.
 0.0008043,     0.,   800., ,    0.6,     0.
 0.0008043,    0.3,   800., ,    0.6,     0.
 0.0009404,     0.,  1160., ,    0.6,     0.
 0.0009404,    0.3,  1160., ,    0.6,     0.
 0.0012488,     0.,  2060., ,    0.6,     0.
 0.0012488,    0.3,  2060., ,    0.6,     0.
 0.0003633,     0.,    80., ,    0.8,     0.
 0.0003633,    0.3,    80., ,    0.8,     0.
 0.0004979,     0.,   440., ,    0.8,     0.
 0.0004979,    0.3,   440., ,    0.8,     0.
 0.0006181,     0.,   800., ,    0.8,     0.
 0.0006181,    0.3,   800., ,    0.8,     0.
 0.0007192,     0.,  1160., ,    0.8,     0.
 0.0007192,    0.3,  1160., ,    0.8,     0.
  0.000954,     0.,  2060., ,    0.8,     0.
  0.000954,    0.3,  2060., ,    0.8,     0.
  0.000264,     0.,    80., ,     1.,     0.
  0.000264,    0.3,    80., ,     1.,     0.
 0.0003631,     0.,   440., ,     1.,     0.
 0.0003631,    0.3,   440., ,     1.,     0.
  0.000452,     0.,   800., ,     1.,     0.
  0.000452,    0.3,   800., ,     1.,     0.
 0.0005237,     0.,  1160., ,     1.,     0.
 0.0005237,    0.3,  1160., ,     1.,     0.
 0.0006978,     0.,  2060., ,     1.,     0.
 0.0006978,    0.3,  2060., ,     1.,     0.
 0.0003213,     0.,    80., ,     0.,  3.82
 0.0003213,    0.3,    80., ,     0.,  3.82
 0.0004579,     0.,   440., ,     0.,  3.82
 0.0004579,    0.3,   440., ,     0.,  3.82
 0.0005789,     0.,   800., ,     0.,  3.82
 0.0005789,    0.3,   800., ,     0.,  3.82
   0.00069,     0.,  1160., ,     0.,  3.82
   0.00069,    0.3,  1160., ,     0.,  3.82
   0.00094,     0.,  2060., ,     0.,  3.82
   0.00094,    0.3,  2060., ,     0.,  3.82
 0.0002722,     0.,    80., ,    0.2,  3.82
 0.0002722,    0.3,    80., ,    0.2,  3.82
 0.0003823,     0.,   440., ,    0.2,  3.82
 0.0003823,    0.3,   440., ,    0.2,  3.82
 0.0004797,     0.,   800., ,    0.2,  3.82
 0.0004797,    0.3,   800., ,    0.2,  3.82
 0.0005675,     0.,  1160., ,    0.2,  3.82
 0.0005675,    0.3,  1160., ,    0.2,  3.82
  0.000764,     0.,  2060., ,    0.2,  3.82
  0.000764,    0.3,  2060., ,    0.2,  3.82
 0.0002251,     0.,    80., ,    0.4,  3.82
 0.0002251,    0.3,    80., ,    0.4,  3.82
 0.0003124,     0.,   440., ,    0.4,  3.82
 0.0003124,    0.3,   440., ,    0.4,  3.82
 0.0003897,     0.,   800., ,    0.4,  3.82
 0.0003897,    0.3,   800., ,    0.4,  3.82
 0.0004581,     0.,  1160., ,    0.4,  3.82
 0.0004581,    0.3,  1160., ,    0.4,  3.82
 0.0006116,     0.,  2060., ,    0.4,  3.82
 0.0006116,    0.3,  2060., ,    0.4,  3.82
 0.0001809,     0.,    80., ,    0.6,  3.82
 0.0001809,    0.3,    80., ,    0.6,  3.82
 0.0002489,     0.,   440., ,    0.6,  3.82
 0.0002489,    0.3,   440., ,    0.6,  3.82
 0.0003094,     0.,   800., ,    0.6,  3.82
 0.0003094,    0.3,   800., ,    0.6,  3.82
 0.0003617,     0.,  1160., ,    0.6,  3.82
 0.0003617,    0.3,  1160., ,    0.6,  3.82
 0.0004803,     0.,  2060., ,    0.6,  3.82
 0.0004803,    0.3,  2060., ,    0.6,  3.82
 0.0001397,     0.,    80., ,    0.8,  3.82
 0.0001397,    0.3,    80., ,    0.8,  3.82
 0.0001915,     0.,   440., ,    0.8,  3.82
 0.0001915,    0.3,   440., ,    0.8,  3.82
 0.0002377,     0.,   800., ,    0.8,  3.82
 0.0002377,    0.3,   800., ,    0.8,  3.82
 0.0002766,     0.,  1160., ,    0.8,  3.82
 0.0002766,    0.3,  1160., ,    0.8,  3.82
 0.0003669,     0.,  2060., ,    0.8,  3.82
 0.0003669,    0.3,  2060., ,    0.8,  3.82
 0.0001015,     0.,    80., ,     1.,  3.82
 0.0001015,    0.3,    80., ,     1.,  3.82
 0.0001396,     0.,   440., ,     1.,  3.82
 0.0001396,    0.3,   440., ,     1.,  3.82
 0.0001738,     0.,   800., ,     1.,  3.82
 0.0001738,    0.3,   800., ,     1.,  3.82
 0.0002014,     0.,  1160., ,     1.,  3.82
 0.0002014,    0.3,  1160., ,     1.,  3.82
 0.0002684,     0.,  2060., ,     1.,  3.82
 0.0002684,    0.3,  2060., ,     1.,  3.82
 0.0001236, 0.3003,  2060., ,     1.,  3.82
```

Capsule 4 Control Gas Gap

```
*Material, name=HE-NE_Control
*Conductivity, dependencies=2
 2.262e-06,  80.,   0.,   0.
 3.223e-06, 440.,   0.,   0.
 4.075e-06, 800.,   0.,   0.
 4.857e-06,1160.,   0.,   0.
 6.618e-06,2060.,   0.,   0.
 1.916e-06,  80.,  0.2,   0.
 2.691e-06, 440.,  0.2,   0.
 3.377e-06, 800.,  0.2,   0.
```

```
3.995e-06,1160.,  0.2,   0.
5.379e-06,2060.,  0.2,   0.
1.585e-06,  80.,  0.4,   0.
  2.2e-06, 440.,  0.4,   0.
2.744e-06, 800.,  0.4,   0.
3.225e-06,1160.,  0.4,   0.
4.306e-06,2060.,  0.4,   0.
1.274e-06,  80.,  0.6,   0.
1.753e-06, 440.,  0.6,   0.
2.178e-06, 800.,  0.6,   0.
2.546e-06,1160.,  0.6,   0.
3.381e-06,2060.,  0.6,   0.
9.836e-07,  80.,  0.8,   0.
1.348e-06, 440.,  0.8,   0.
1.674e-06, 800.,  0.8,   0.
1.947e-06,1160.,  0.8,   0.
2.583e-06,2060.,  0.8,   0.
7.149e-07,  80.,   1.,   0.
9.831e-07, 440.,   1.,   0.
1.224e-06, 800.,   1.,   0.
1.418e-06,1160.,   1.,   0.
1.889e-06,2060.,   1.,   0.
4.523e-06,  80.,   0., 3.78
6.447e-06, 440.,   0., 3.78
8.151e-06, 800.,   0., 3.78
9.715e-06,1160.,   0., 3.78
1.324e-05,2060.,   0., 3.78
3.833e-06,  80.,  0.2, 3.78
5.383e-06, 440.,  0.2, 3.78
6.754e-06, 800.,  0.2, 3.78
 7.99e-06,1160.,  0.2, 3.78
1.076e-05,2060.,  0.2, 3.78
 3.17e-06,  80.,  0.4, 3.78
4.399e-06, 440.,  0.4, 3.78
5.488e-06, 800.,  0.4, 3.78
6.451e-06,1160.,  0.4, 3.78
8.611e-06,2060.,  0.4, 3.78
2.547e-06,  80.,  0.6, 3.78
3.505e-06, 440.,  0.6, 3.78
4.356e-06, 800.,  0.6, 3.78
5.092e-06,1160.,  0.6, 3.78
6.763e-06,2060.,  0.6, 3.78
1.967e-06,  80.,  0.8, 3.78
2.697e-06, 440.,  0.8, 3.78
3.347e-06, 800.,  0.8, 3.78
3.895e-06,1160.,  0.8, 3.78
5.166e-06,2060.,  0.8, 3.78
 1.43e-06,  80.,   1., 3.78
1.966e-06, 440.,   1., 3.78
2.448e-06, 800.,   1., 3.78
2.836e-06,1160.,   1., 3.78
3.779e-06,2060.,   1., 3.78
```

Capsule 4 Compact – Graphite Holder Gap

```
*Gap Conductance, dependencies=2
 0.0008353,     0.,    80., ,     0.,     0.
 0.0008353,    0.3,    80., ,     0.,     0.
 0.0011905,     0.,   440., ,     0.,     0.
 0.0011905,    0.3,   440., ,     0.,     0.
 0.0015051,     0.,   800., ,     0.,     0.
 0.0015051,    0.3,   800., ,     0.,     0.
 0.0017939,     0.,  1160., ,     0.,     0.
 0.0017939,    0.3,  1160., ,     0.,     0.
 0.0024441,     0.,  2060., ,     0.,     0.
 0.0024441,    0.3,  2060., ,     0.,     0.
 0.0007078,     0.,    80., ,    0.2,     0.
 0.0007078,    0.3,    80., ,    0.2,     0.
  0.000994,     0.,   440., ,    0.2,     0.
  0.000994,    0.3,   440., ,    0.2,     0.
 0.0012471,     0.,   800., ,    0.2,     0.
 0.0012471,    0.3,   800., ,    0.2,     0.
 0.0014754,     0.,  1160., ,    0.2,     0.
 0.0014754,    0.3,  1160., ,    0.2,     0.
 0.0019864,     0.,  2060., ,    0.2,     0.
 0.0019864,    0.3,  2060., ,    0.2,     0.
 0.0005854,     0.,    80., ,    0.4,     0.
 0.0005854,    0.3,    80., ,    0.4,     0.
 0.0008124,     0.,   440., ,    0.4,     0.
 0.0008124,    0.3,   440., ,    0.4,     0.
 0.0010133,     0.,   800., ,    0.4,     0.
 0.0010133,    0.3,   800., ,    0.4,     0.
 0.0011912,     0.,  1160., ,    0.4,     0.
 0.0011912,    0.3,  1160., ,    0.4,     0.
 0.0015901,     0.,  2060., ,    0.4,     0.
 0.0015901,    0.3,  2060., ,    0.4,     0.
 0.0004703,     0.,    80., ,    0.6,     0.
 0.0004703,    0.3,    80., ,    0.6,     0.
 0.0006472,     0.,   440., ,    0.6,     0.
 0.0006472,    0.3,   440., ,    0.6,     0.
 0.0008043,     0.,   800., ,    0.6,     0.
 0.0008043,    0.3,   800., ,    0.6,     0.
 0.0009404,     0.,  1160., ,    0.6,     0.
 0.0009404,    0.3,  1160., ,    0.6,     0.
 0.0012488,     0.,  2060., ,    0.6,     0.
 0.0012488,    0.3,  2060., ,    0.6,     0.
 0.0003633,     0.,    80., ,    0.8,     0.
 0.0003633,    0.3,    80., ,    0.8,     0.
 0.0004979,     0.,   440., ,    0.8,     0.
 0.0004979,    0.3,   440., ,    0.8,     0.
 0.0006181,     0.,   800., ,    0.8,     0.
 0.0006181,    0.3,   800., ,    0.8,     0.
 0.0007192,     0.,  1160., ,    0.8,     0.
 0.0007192,    0.3,  1160., ,    0.8,     0.
  0.000954,     0.,  2060., ,    0.8,     0.
  0.000954,    0.3,  2060., ,    0.8,     0.
  0.000264,     0.,    80., ,     1.,     0.
  0.000264,    0.3,    80., ,     1.,     0.
 0.0003631,     0.,   440., ,     1.,     0.
 0.0003631,    0.3,   440., ,     1.,     0.
  0.000452,     0.,   800., ,     1.,     0.
  0.000452,    0.3,   800., ,     1.,     0.
 0.0005237,     0.,  1160., ,     1.,     0.
 0.0005237,    0.3,  1160., ,     1.,     0.
 0.0006978,     0.,  2060., ,     1.,     0.
 0.0006978,    0.3,  2060., ,     1.,     0.
 0.0003213,     0.,    80., ,     0.,   3.78
 0.0003213,    0.3,    80., ,     0.,   3.78
 0.0004579,     0.,   440., ,     0.,   3.78
 0.0004579,    0.3,   440., ,     0.,   3.78
 0.0005789,     0.,   800., ,     0.,   3.78
 0.0005789,    0.3,   800., ,     0.,   3.78
   0.00069,     0.,  1160., ,     0.,   3.78
   0.00069,    0.3,  1160., ,     0.,   3.78
   0.00094,     0.,  2060., ,     0.,   3.78
   0.00094,    0.3,  2060., ,     0.,   3.78
 0.0002722,     0.,    80., ,    0.2,   3.78
 0.0002722,    0.3,    80., ,    0.2,   3.78
 0.0003823,     0.,   440., ,    0.2,   3.78
 0.0003823,    0.3,   440., ,    0.2,   3.78
 0.0004797,     0.,   800., ,    0.2,   3.78
 0.0004797,    0.3,   800., ,    0.2,   3.78
 0.0005675,     0.,  1160., ,    0.2,   3.78
 0.0005675,    0.3,  1160., ,    0.2,   3.78
  0.000764,     0.,  2060., ,    0.2,   3.78
  0.000764,    0.3,  2060., ,    0.2,   3.78
 0.0002251,     0.,    80., ,    0.4,   3.78
 0.0002251,    0.3,    80., ,    0.4,   3.78
 0.0003124,     0.,   440., ,    0.4,   3.78
 0.0003124,    0.3,   440., ,    0.4,   3.78
 0.0003897,     0.,   800., ,    0.4,   3.78
 0.0003897,    0.3,   800., ,    0.4,   3.78
 0.0004581,     0.,  1160., ,    0.4,   3.78
 0.0004581,    0.3,  1160., ,    0.4,   3.78
 0.0006116,     0.,  2060., ,    0.4,   3.78
 0.0006116,    0.3,  2060., ,    0.4,   3.78
 0.0001809,     0.,    80., ,    0.6,   3.78
 0.0001809,    0.3,    80., ,    0.6,   3.78
 0.0002489,     0.,   440., ,    0.6,   3.78
 0.0002489,    0.3,   440., ,    0.6,   3.78
 0.0003094,     0.,   800., ,    0.6,   3.78
 0.0003094,    0.3,   800., ,    0.6,   3.78
 0.0003617,     0.,  1160., ,    0.6,   3.78
 0.0003617,    0.3,  1160., ,    0.6,   3.78
 0.0004803,     0.,  2060., ,    0.6,   3.78
 0.0004803,    0.3,  2060., ,    0.6,   3.78
 0.0001397,     0.,    80., ,    0.8,   3.78
 0.0001397,    0.3,    80., ,    0.8,   3.78
 0.0001915,     0.,   440., ,    0.8,   3.78
 0.0001915,    0.3,   440., ,    0.8,   3.78
 0.0002377,     0.,   800., ,    0.8,   3.78
 0.0002377,    0.3,   800., ,    0.8,   3.78
 0.0002766,     0.,  1160., ,    0.8,   3.78
 0.0002766,    0.3,  1160., ,    0.8,   3.78
 0.0003669,     0.,  2060., ,    0.8,   3.78
 0.0003669,    0.3,  2060., ,    0.8,   3.78
 0.0001015,     0.,    80., ,     1.,   3.78
 0.0001015,    0.3,    80., ,     1.,   3.78
 0.0001396,     0.,   440., ,     1.,   3.78
 0.0001396,    0.3,   440., ,     1.,   3.78
 0.0001738,     0.,   800., ,     1.,   3.78
 0.0001738,    0.3,   800., ,     1.,   3.78
 0.0002014,     0.,  1160., ,     1.,   3.78
 0.0002014,    0.3,  1160., ,     1.,   3.78
 0.0002684,     0.,  2060., ,     1.,   3.78
 0.0002684,    0.3,  2060., ,     1.,   3.78
 0.0001236, 0.3003,  2060., ,     1.,   3.78
```

Capsule 5 Control Gas Gap

```
*Material, name=HE-NE_Control_Gas
*Conductivity, dependencies=3
 2.225e-06,  80.,   0.,   0.,   0.
 3.171e-06, 440.,   0.,   0.,   0.
```

```
4.009e-06, 800.,   0.,   0.,   0.
4.778e-06,1160.,   0.,   0.,   0.
 6.51e-06,2060.,   0.,   0.,   0.
1.885e-06,  80.,  0.2,   0.,   0.
2.647e-06, 440.,  0.2,   0.,   0.
3.322e-06, 800.,  0.2,   0.,   0.
 3.93e-06,1160.,  0.2,   0.,   0.
5.291e-06,2060.,  0.2,   0.,   0.
1.559e-06,  80.,  0.4,   0.,   0.
2.164e-06, 440.,  0.4,   0.,   0.
2.699e-06, 800.,  0.4,   0.,   0.
3.173e-06,1160.,  0.4,   0.,   0.
4.235e-06,2060.,  0.4,   0.,   0.
1.253e-06,  80.,  0.6,   0.,   0.
1.724e-06, 440.,  0.6,   0.,   0.
2.142e-06, 800.,  0.6,   0.,   0.
2.505e-06,1160.,  0.6,   0.,   0.
3.326e-06,2060.,  0.6,   0.,   0.
9.675e-07,  80.,  0.8,   0.,   0.
1.326e-06, 440.,  0.8,   0.,   0.
1.646e-06, 800.,  0.8,   0.,   0.
1.916e-06,1160.,  0.8,   0.,   0.
2.541e-06,2060.,  0.8,   0.,   0.
7.032e-07,  80.,   1.,   0.,   0.
9.671e-07, 440.,   1.,   0.,   0.
1.204e-06, 800.,   1.,   0.,   0.
1.395e-06,1160.,   1.,   0.,   0.
1.859e-06,2060.,   1.,   0.,   0.
5.327e-06,  80.,   0., 3.37,   0.
7.593e-06, 440.,   0., 3.37,   0.
  9.6e-06, 800.,   0., 3.37,   0.
1.144e-05,1160.,   0., 3.37,   0.
1.559e-05,2060.,   0., 3.37,   0.
4.514e-06,  80.,  0.2, 3.37,   0.
 6.34e-06, 440.,  0.2, 3.37,   0.
7.955e-06, 800.,  0.2, 3.37,   0.
 9.41e-06,1160.,  0.2, 3.37,   0.
1.267e-05,2060.,  0.2, 3.37,   0.
3.734e-06,  80.,  0.4, 3.37,   0.
5.181e-06, 440.,  0.4, 3.37,   0.
6.463e-06, 800.,  0.4, 3.37,   0.
7.598e-06,1160.,  0.4, 3.37,   0.
1.014e-05,2060.,  0.4, 3.37,   0.
    3e-06,  80.,  0.6, 3.37,   0.
4.128e-06, 440.,  0.6, 3.37,   0.
 5.13e-06, 800.,  0.6, 3.37,   0.
5.998e-06,1160.,  0.6, 3.37,   0.
7.965e-06,2060.,  0.6, 3.37,   0.
2.317e-06,  80.,  0.8, 3.37,   0.
3.176e-06, 440.,  0.8, 3.37,   0.
3.942e-06, 800.,  0.8, 3.37,   0.
4.587e-06,1160.,  0.8, 3.37,   0.
6.085e-06,2060.,  0.8, 3.37,   0.
1.684e-06,  80.,   1., 3.37,   0.
2.316e-06, 440.,   1., 3.37,   0.
2.883e-06, 800.,   1., 3.37,   0.
3.341e-06,1160.,   1., 3.37,   0.
4.451e-06,2060.,   1., 3.37,   0.
2.225e-06,  80.,   0.,   0., 0.33
3.171e-06, 440.,   0.,   0., 0.33
4.009e-06, 800.,   0.,   0., 0.33
4.778e-06,1160.,   0.,   0., 0.33
 6.51e-06,2060.,   0.,   0., 0.33
1.885e-06,  80.,  0.2,   0., 0.33
2.647e-06, 440.,  0.2,   0., 0.33
3.322e-06, 800.,  0.2,   0., 0.33
 3.93e-06,1160.,  0.2,   0., 0.33
5.291e-06,2060.,  0.2,   0., 0.33
1.559e-06,  80.,  0.4,   0., 0.33
2.164e-06, 440.,  0.4,   0., 0.33
2.699e-06, 800.,  0.4,   0., 0.33
3.173e-06,1160.,  0.4,   0., 0.33
4.235e-06,2060.,  0.4,   0., 0.33
1.253e-06,  80.,  0.6,   0., 0.33
1.724e-06, 440.,  0.6,   0., 0.33
2.142e-06, 800.,  0.6,   0., 0.33
2.505e-06,1160.,  0.6,   0., 0.33
3.326e-06,2060.,  0.6,   0., 0.33
9.675e-07,  80.,  0.8,   0., 0.33
1.326e-06, 440.,  0.8,   0., 0.33
1.646e-06, 800.,  0.8,   0., 0.33
1.916e-06,1160.,  0.8,   0., 0.33
2.541e-06,2060.,  0.8,   0., 0.33
7.032e-07,  80.,   1.,   0., 0.33
9.671e-07, 440.,   1.,   0., 0.33
1.204e-06, 800.,   1.,   0., 0.33
1.395e-06,1160.,   1.,   0., 0.33
1.859e-06,2060.,   1.,   0., 0.33
5.327e-06,  80.,   0., 3.37, 0.33
7.593e-06, 440.,   0., 3.37, 0.33
  9.6e-06, 800.,   0., 3.37, 0.33
1.144e-05,1160.,   0., 3.37, 0.33
1.559e-05,2060.,   0., 3.37, 0.33
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4.514e-06,  80.,  0.2, 3.37, 0.33
 6.34e-06, 440.,  0.2, 3.37, 0.33
7.955e-06, 800.,  0.2, 3.37, 0.33
 9.41e-06,1160.,  0.2, 3.37, 0.33
1.267e-05,2060.,  0.2, 3.37, 0.33
3.734e-06,  80.,  0.4, 3.37, 0.33
5.181e-06, 440.,  0.4, 3.37, 0.33
6.463e-06, 800.,  0.4, 3.37, 0.33
7.598e-06,1160.,  0.4, 3.37, 0.33
1.014e-05,2060.,  0.4, 3.37, 0.33
    3e-06,  80.,  0.6, 3.37, 0.33
4.128e-06, 440.,  0.6, 3.37, 0.33
 5.13e-06, 800.,  0.6, 3.37, 0.33
5.998e-06,1160.,  0.6, 3.37, 0.33
7.965e-06,2060.,  0.6, 3.37, 0.33
2.317e-06,  80.,  0.8, 3.37, 0.33
3.176e-06, 440.,  0.8, 3.37, 0.33
3.942e-06, 800.,  0.8, 3.37, 0.33
4.587e-06,1160.,  0.8, 3.37, 0.33
6.085e-06,2060.,  0.8, 3.37, 0.33
1.684e-06,  80.,   1., 3.37, 0.33
2.316e-06, 440.,   1., 3.37, 0.33
2.883e-06, 800.,   1., 3.37, 0.33
3.341e-06,1160.,   1., 3.37, 0.33
4.451e-06,2060.,   1., 3.37, 0.33
2.225e-06,  80.,   0.,   0.,   1.
3.171e-06, 440.,   0.,   0.,   1.
4.009e-06, 800.,   0.,   0.,   1.
4.778e-06,1160.,   0.,   0.,   1.
 6.51e-06,2060.,   0.,   0.,   1.
1.885e-06,  80.,  0.2,   0.,   1.
2.647e-06, 440.,  0.2,   0.,   1.
3.322e-06, 800.,  0.2,   0.,   1.
 3.93e-06,1160.,  0.2,   0.,   1.
5.291e-06,2060.,  0.2,   0.,   1.
1.559e-06,  80.,  0.4,   0.,   1.
2.164e-06, 440.,  0.4,   0.,   1.
2.699e-06, 800.,  0.4,   0.,   1.
3.173e-06,1160.,  0.4,   0.,   1.
4.235e-06,2060.,  0.4,   0.,   1.
1.253e-06,  80.,  0.6,   0.,   1.
1.724e-06, 440.,  0.6,   0.,   1.
2.142e-06, 800.,  0.6,   0.,   1.
2.505e-06,1160.,  0.6,   0.,   1.
3.326e-06,2060.,  0.6,   0.,   1.
9.675e-07,  80.,  0.8,   0.,   1.
1.326e-06, 440.,  0.8,   0.,   1.
1.646e-06, 800.,  0.8,   0.,   1.
1.916e-06,1160.,  0.8,   0.,   1.
2.541e-06,2060.,  0.8,   0.,   1.
7.032e-07,  80.,   1.,   0.,   1.
9.671e-07, 440.,   1.,   0.,   1.
1.204e-06, 800.,   1.,   0.,   1.
1.395e-06,1160.,   1.,   0.,   1.
1.859e-06,2060.,   1.,   0.,   1.
3.139e-06,  80.,   0., 3.37,   1.
4.473e-06, 440.,   0., 3.37,   1.
5.656e-06, 800.,   0., 3.37,   1.
6.741e-06,1160.,   0., 3.37,   1.
9.184e-06,2060.,   0., 3.37,   1.
 2.66e-06,  80.,  0.2, 3.37,   1.
3.735e-06, 440.,  0.2, 3.37,   1.
4.686e-06, 800.,  0.2, 3.37,   1.
5.544e-06,1160.,  0.2, 3.37,   1.
7.464e-06,2060.,  0.2, 3.37,   1.
  2.2e-06,  80.,  0.4, 3.37,   1.
3.053e-06, 440.,  0.4, 3.37,   1.
3.808e-06, 800.,  0.4, 3.37,   1.
4.476e-06,1160.,  0.4, 3.37,   1.
5.975e-06,2060.,  0.4, 3.37,   1.
1.767e-06,  80.,  0.6, 3.37,   1.
2.432e-06, 440.,  0.6, 3.37,   1.
3.023e-06, 800.,  0.6, 3.37,   1.
3.534e-06,1160.,  0.6, 3.37,   1.
4.693e-06,2060.,  0.6, 3.37,   1.
1.365e-06,  80.,  0.8, 3.37,   1.
1.871e-06, 440.,  0.8, 3.37,   1.
2.323e-06, 800.,  0.8, 3.37,   1.
2.703e-06,1160.,  0.8, 3.37,   1.
3.585e-06,2060.,  0.8, 3.37,   1.
9.921e-07,  80.,   1., 3.37,   1.
1.364e-06, 440.,   1., 3.37,   1.
1.698e-06, 800.,   1., 3.37,   1.
1.968e-06,1160.,   1., 3.37,   1.
2.622e-06,2060.,   1., 3.37,   1.
2.225e-06,  80.,   0.,   0., 1.67
3.171e-06, 440.,   0.,   0., 1.67
4.009e-06, 800.,   0.,   0., 1.67
4.778e-06,1160.,   0.,   0., 1.67
 6.51e-06,2060.,   0.,   0., 1.67
1.885e-06,  80.,  0.2,   0., 1.67
2.647e-06, 440.,  0.2,   0., 1.67
3.322e-06, 800.,  0.2,   0., 1.67
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 3.93e-06,1160.,  0.2,   0., 1.67
5.291e-06,2060.,  0.2,   0., 1.67
1.559e-06,  80.,  0.4,   0., 1.67
2.164e-06, 440.,  0.4,   0., 1.67
2.699e-06, 800.,  0.4,   0., 1.67
3.173e-06,1160.,  0.4,   0., 1.67
4.235e-06,2060.,  0.4,   0., 1.67
1.253e-06,  80.,  0.6,   0., 1.67
1.724e-06, 440.,  0.6,   0., 1.67
2.142e-06, 800.,  0.6,   0., 1.67
2.505e-06,1160.,  0.6,   0., 1.67
3.326e-06,2060.,  0.6,   0., 1.67
9.675e-07,  80.,  0.8,   0., 1.67
1.326e-06, 440.,  0.8,   0., 1.67
1.646e-06, 800.,  0.8,   0., 1.67
1.916e-06,1160.,  0.8,   0., 1.67
2.541e-06,2060.,  0.8,   0., 1.67
7.032e-07,  80.,   1.,   0., 1.67
9.671e-07, 440.,   1.,   0., 1.67
1.204e-06, 800.,   1.,   0., 1.67
1.395e-06,1160.,   1.,   0., 1.67
1.859e-06,2060.,   1.,   0., 1.67
3.651e-06,  80.,   0., 3.37, 1.67
5.203e-06, 440.,   0., 3.37, 1.67
6.579e-06, 800.,   0., 3.37, 1.67
7.841e-06,1160.,   0., 3.37, 1.67
1.068e-05,2060.,   0., 3.37, 1.67
3.094e-06,  80.,  0.2, 3.37, 1.67
4.345e-06, 440.,  0.2, 3.37, 1.67
5.451e-06, 800.,  0.2, 3.37, 1.67
6.449e-06,1160.,  0.2, 3.37, 1.67
8.683e-06,2060.,  0.2, 3.37, 1.67
2.559e-06,  80.,  0.4, 3.37, 1.67
3.551e-06, 440.,  0.4, 3.37, 1.67
4.429e-06, 800.,  0.4, 3.37, 1.67
5.207e-06,1160.,  0.4, 3.37, 1.67
 6.95e-06,2060.,  0.4, 3.37, 1.67
2.056e-06,  80.,  0.6, 3.37, 1.67
2.829e-06, 440.,  0.6, 3.37, 1.67
3.516e-06, 800.,  0.6, 3.37, 1.67
 4.11e-06,1160.,  0.6, 3.37, 1.67
5.458e-06,2060.,  0.6, 3.37, 1.67
1.588e-06,  80.,  0.8, 3.37, 1.67
2.176e-06, 440.,  0.8, 3.37, 1.67
2.702e-06, 800.,  0.8, 3.37, 1.67
3.144e-06,1160.,  0.8, 3.37, 1.67
 4.17e-06,2060.,  0.8, 3.37, 1.67
1.154e-06,  80.,   1., 3.37, 1.67
1.587e-06, 440.,   1., 3.37, 1.67
1.976e-06, 800.,   1., 3.37, 1.67
2.289e-06,1160.,   1., 3.37, 1.67
 3.05e-06,2060.,   1., 3.37, 1.67
2.225e-06,  80.,   0.,   0., 2.33
3.171e-06, 440.,   0.,   0., 2.33
4.009e-06, 800.,   0.,   0., 2.33
4.778e-06,1160.,   0.,   0., 2.33
 6.51e-06,2060.,   0.,   0., 2.33
1.885e-06,  80.,  0.2,   0., 2.33
2.647e-06, 440.,  0.2,   0., 2.33
3.322e-06, 800.,  0.2,   0., 2.33
 3.93e-06,1160.,  0.2,   0., 2.33
5.291e-06,2060.,  0.2,   0., 2.33
1.559e-06,  80.,  0.4,   0., 2.33
2.164e-06, 440.,  0.4,   0., 2.33
2.699e-06, 800.,  0.4,   0., 2.33
3.173e-06,1160.,  0.4,   0., 2.33
4.235e-06,2060.,  0.4,   0., 2.33
1.253e-06,  80.,  0.6,   0., 2.33
1.724e-06, 440.,  0.6,   0., 2.33
2.142e-06, 800.,  0.6,   0., 2.33
2.505e-06,1160.,  0.6,   0., 2.33
3.326e-06,2060.,  0.6,   0., 2.33
9.675e-07,  80.,  0.8,   0., 2.33
1.326e-06, 440.,  0.8,   0., 2.33
1.646e-06, 800.,  0.8,   0., 2.33
1.916e-06,1160.,  0.8,   0., 2.33
2.541e-06,2060.,  0.8,   0., 2.33
7.032e-07,  80.,   1.,   0., 2.33
9.671e-07, 440.,   1.,   0., 2.33
1.204e-06, 800.,   1.,   0., 2.33
1.395e-06,1160.,   1.,   0., 2.33
1.859e-06,2060.,   1.,   0., 2.33
4.725e-06,  80.,   0., 3.37, 2.33
6.734e-06, 440.,   0., 3.37, 2.33
8.514e-06, 800.,   0., 3.37, 2.33
1.015e-05,1160.,   0., 3.37, 2.33
1.383e-05,2060.,   0., 3.37, 2.33
4.004e-06,  80.,  0.2, 3.37, 2.33
5.623e-06, 440.,  0.2, 3.37, 2.33
7.055e-06, 800.,  0.2, 3.37, 2.33
8.346e-06,1160.,  0.2, 3.37, 2.33
1.124e-05,2060.,  0.2, 3.37, 2.33
3.311e-06,  80.,  0.4, 3.37, 2.33
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4.595e-06, 440.,  0.4, 3.37, 2.33
5.732e-06, 800.,  0.4, 3.37, 2.33
6.738e-06,1160.,  0.4, 3.37, 2.33
8.995e-06,2060.,  0.4, 3.37, 2.33
2.661e-06,  80.,  0.6, 3.37, 2.33
3.661e-06, 440.,  0.6, 3.37, 2.33
 4.55e-06, 800.,  0.6, 3.37, 2.33
5.319e-06,1160.,  0.6, 3.37, 2.33
7.064e-06,2060.,  0.6, 3.37, 2.33
2.055e-06,  80.,  0.8, 3.37, 2.33
2.817e-06, 440.,  0.8, 3.37, 2.33
3.496e-06, 800.,  0.8, 3.37, 2.33
4.068e-06,1160.,  0.8, 3.37, 2.33
5.396e-06,2060.,  0.8, 3.37, 2.33
1.493e-06,  80.,   1., 3.37, 2.33
2.054e-06, 440.,   1., 3.37, 2.33
2.557e-06, 800.,   1., 3.37, 2.33
2.963e-06,1160.,   1., 3.37, 2.33
3.947e-06,2060.,   1., 3.37, 2.33
2.225e-06,  80.,   0.,   0.,   3.
3.171e-06, 440.,   0.,   0.,   3.
4.009e-06, 800.,   0.,   0.,   3.
4.778e-06,1160.,   0.,   0.,   3.
 6.51e-06,2060.,   0.,   0.,   3.
1.885e-06,  80.,  0.2,   0.,   3.
2.647e-06, 440.,  0.2,   0.,   3.
3.322e-06, 800.,  0.2,   0.,   3.
 3.93e-06,1160.,  0.2,   0.,   3.
5.291e-06,2060.,  0.2,   0.,   3.
1.559e-06,  80.,  0.4,   0.,   3.
2.164e-06, 440.,  0.4,   0.,   3.
2.699e-06, 800.,  0.4,   0.,   3.
3.173e-06,1160.,  0.4,   0.,   3.
4.235e-06,2060.,  0.4,   0.,   3.
1.253e-06,  80.,  0.6,   0.,   3.
1.724e-06, 440.,  0.6,   0.,   3.
2.142e-06, 800.,  0.6,   0.,   3.
2.505e-06,1160.,  0.6,   0.,   3.
3.326e-06,2060.,  0.6,   0.,   3.
9.675e-07,  80.,  0.8,   0.,   3.
1.326e-06, 440.,  0.8,   0.,   3.
1.646e-06, 800.,  0.8,   0.,   3.
1.916e-06,1160.,  0.8,   0.,   3.
2.541e-06,2060.,  0.8,   0.,   3.
7.032e-07,  80.,   1.,   0.,   3.
9.671e-07, 440.,   1.,   0.,   3.
1.204e-06, 800.,   1.,   0.,   3.
1.395e-06,1160.,   1.,   0.,   3.
1.859e-06,2060.,   1.,   0.,   3.
7.235e-06,  80.,   0., 3.37,   3.
1.031e-05, 440.,   0., 3.37,   3.
1.304e-05, 800.,   0., 3.37,   3.
1.554e-05,1160.,   0., 3.37,   3.
2.117e-05,2060.,   0., 3.37,   3.
 6.13e-06,  80.,  0.2, 3.37,   3.
 8.61e-06, 440.,  0.2, 3.37,   3.
 1.08e-05, 800.,  0.2, 3.37,   3.
1.278e-05,1160.,  0.2, 3.37,   3.
1.721e-05,2060.,  0.2, 3.37,   3.
 5.07e-06,  80.,  0.4, 3.37,   3.
7.036e-06, 440.,  0.4, 3.37,   3.
8.777e-06, 800.,  0.4, 3.37,   3.
1.032e-05,1160.,  0.4, 3.37,   3.
1.377e-05,2060.,  0.4, 3.37,   3.
4.074e-06,  80.,  0.6, 3.37,   3.
5.606e-06, 440.,  0.6, 3.37,   3.
6.967e-06, 800.,  0.6, 3.37,   3.
8.145e-06,1160.,  0.6, 3.37,   3.
1.082e-05,2060.,  0.6, 3.37,   3.
3.146e-06,  80.,  0.8, 3.37,   3.
4.313e-06, 440.,  0.8, 3.37,   3.
5.354e-06, 800.,  0.8, 3.37,   3.
 6.23e-06,1160.,  0.8, 3.37,   3.
8.263e-06,2060.,  0.8, 3.37,   3.
2.287e-06,  80.,   1., 3.37,   3.
3.145e-06, 440.,   1., 3.37,   3.
3.915e-06, 800.,   1., 3.37,   3.
4.536e-06,1160.,   1., 3.37,   3.
6.044e-06,2060.,   1., 3.37,   3.
2.225e-06,  80.,   0.,   0., 3.67
3.171e-06, 440.,   0.,   0., 3.67
4.009e-06, 800.,   0.,   0., 3.67
4.778e-06,1160.,   0.,   0., 3.67
 6.51e-06,2060.,   0.,   0., 3.67
1.885e-06,  80.,  0.2,   0., 3.67
2.647e-06, 440.,  0.2,   0., 3.67
3.322e-06, 800.,  0.2,   0., 3.67
 3.93e-06,1160.,  0.2,   0., 3.67
5.291e-06,2060.,  0.2,   0., 3.67
1.559e-06,  80.,  0.4,   0., 3.67
2.164e-06, 440.,  0.4,   0., 3.67
2.699e-06, 800.,  0.4,   0., 3.67
3.173e-06,1160.,  0.4,   0., 3.67
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4.235e-06,2060.,  0.4,   0., 3.67
1.253e-06,  80.,  0.6,   0., 3.67
1.724e-06, 440.,  0.6,   0., 3.67
2.142e-06, 800.,  0.6,   0., 3.67
2.505e-06,1160.,  0.6,   0., 3.67
3.326e-06,2060.,  0.6,   0., 3.67
9.675e-07,  80.,  0.8,   0., 3.67
1.326e-06, 440.,  0.8,   0., 3.67
1.646e-06, 800.,  0.8,   0., 3.67
1.916e-06,1160.,  0.8,   0., 3.67
2.541e-06,2060.,  0.8,   0., 3.67
7.032e-07,  80.,   1.,   0., 3.67
9.671e-07, 440.,   1.,   0., 3.67
1.204e-06, 800.,   1.,   0., 3.67
1.395e-06,1160.,   1.,   0., 3.67
1.859e-06,2060.,   1.,   0., 3.67
 3.37e-05,  80.,   0., 3.37, 3.67
4.803e-05, 440.,   0., 3.37, 3.67
6.073e-05, 800.,   0., 3.37, 3.67
7.238e-05,1160.,   0., 3.37, 3.67
9.861e-05,2060.,   0., 3.37, 3.67
2.856e-05,  80.,  0.2, 3.37, 3.67
4.011e-05, 440.,  0.2, 3.37, 3.67
5.032e-05, 800.,  0.2, 3.37, 3.67
5.953e-05,1160.,  0.2, 3.37, 3.67
8.015e-05,2060.,  0.2, 3.37, 3.67
2.362e-05,  80.,  0.4, 3.37, 3.67
3.278e-05, 440.,  0.4, 3.37, 3.67
4.089e-05, 800.,  0.4, 3.37, 3.67
4.806e-05,1160.,  0.4, 3.37, 3.67
6.416e-05,2060.,  0.4, 3.37, 3.67
1.898e-05,  80.,  0.6, 3.37, 3.67
2.611e-05, 440.,  0.6, 3.37, 3.67
3.245e-05, 800.,  0.6, 3.37, 3.67
3.794e-05,1160.,  0.6, 3.37, 3.67
5.039e-05,2060.,  0.6, 3.37, 3.67
1.466e-05,  80.,  0.8, 3.37, 3.67
2.009e-05, 440.,  0.8, 3.37, 3.67
2.494e-05, 800.,  0.8, 3.37, 3.67
2.902e-05,1160.,  0.8, 3.37, 3.67
3.849e-05,2060.,  0.8, 3.37, 3.67
1.065e-05,  80.,   1., 3.37, 3.67
1.465e-05, 440.,   1., 3.37, 3.67
1.824e-05, 800.,   1., 3.37, 3.67
2.113e-05,1160.,   1., 3.37, 3.67
2.815e-05,2060.,   1., 3.37, 3.67
2.225e-06,  80.,   0.,   0.,   4.
3.171e-06, 440.,   0.,   0.,   4.
4.009e-06, 800.,   0.,   0.,   4.
4.778e-06,1160.,   0.,   0.,   4.
 6.51e-06,2060.,   0.,   0.,   4.
1.885e-06,  80.,  0.2,   0.,   4.
2.647e-06, 440.,  0.2,   0.,   4.
3.322e-06, 800.,  0.2,   0.,   4.
 3.93e-06,1160.,  0.2,   0.,   4.
5.291e-06,2060.,  0.2,   0.,   4.
1.559e-06,  80.,  0.4,   0.,   4.
2.164e-06, 440.,  0.4,   0.,   4.
2.699e-06, 800.,  0.4,   0.,   4.
3.173e-06,1160.,  0.4,   0.,   4.
4.235e-06,2060.,  0.4,   0.,   4.
1.253e-06,  80.,  0.6,   0.,   4.
1.724e-06, 440.,  0.6,   0.,   4.
2.142e-06, 800.,  0.6,   0.,   4.
2.505e-06,1160.,  0.6,   0.,   4.
3.326e-06,2060.,  0.6,   0.,   4.
9.675e-07,  80.,  0.8,   0.,   4.
1.326e-06, 440.,  0.8,   0.,   4.
1.646e-06, 800.,  0.8,   0.,   4.
1.916e-06,1160.,  0.8,   0.,   4.
2.541e-06,2060.,  0.8,   0.,   4.
7.032e-07,  80.,   1.,   0.,   4.
9.671e-07, 440.,   1.,   0.,   4.
1.204e-06, 800.,   1.,   0.,   4.
1.395e-06,1160.,   1.,   0.,   4.
1.859e-06,2060.,   1.,   0.,   4.
 3.37e-05,  80.,   0., 3.37,   4.
4.803e-05, 440.,   0., 3.37,   4.
6.073e-05, 800.,   0., 3.37,   4.
7.238e-05,1160.,   0., 3.37,   4.
9.861e-05,2060.,   0., 3.37,   4.
2.856e-05,  80.,  0.2, 3.37,   4.
4.011e-05, 440.,  0.2, 3.37,   4.
5.032e-05, 800.,  0.2, 3.37,   4.
5.953e-05,1160.,  0.2, 3.37,   4.
8.015e-05,2060.,  0.2, 3.37,   4.
2.362e-05,  80.,  0.4, 3.37,   4.
3.278e-05, 440.,  0.4, 3.37,   4.
4.089e-05, 800.,  0.4, 3.37,   4.
4.806e-05,1160.,  0.4, 3.37,   4.
6.416e-05,2060.,  0.4, 3.37,   4.
1.898e-05,  80.,  0.6, 3.37,   4.
2.611e-05, 440.,  0.6, 3.37,   4.
3.245e-05, 800.,  0.6, 3.37,   4.
3.794e-05,1160.,  0.6, 3.37,   4.
5.039e-05,2060.,  0.6, 3.37,   4.
1.466e-05,  80.,  0.8, 3.37,   4.
2.009e-05, 440.,  0.8, 3.37,   4.
2.494e-05, 800.,  0.8, 3.37,   4.
2.902e-05,1160.,  0.8, 3.37,   4.
3.849e-05,2060.,  0.8, 3.37,   4.
1.065e-05,  80.,   1., 3.37,   4.
1.465e-05, 440.,   1., 3.37,   4.
1.824e-05, 800.,   1., 3.37,   4.
2.113e-05,1160.,   1., 3.37,   4.
2.815e-05,2060.,   1., 3.37,   4.
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Capsule 5 Compact – Graphite Holder Gap

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*Gap Conductance, dependencies=2
 0.0008353,     0.,    80., ,     0.,     0.
 0.0008353,    0.3,    80., ,     0.,     0.
 0.0011905,     0.,   440., ,     0.,     0.
 0.0011905,    0.3,   440., ,     0.,     0.
 0.0015051,     0.,   800., ,     0.,     0.
 0.0015051,    0.3,   800., ,     0.,     0.
 0.0017939,     0.,  1160., ,     0.,     0.
 0.0017939,    0.3,  1160., ,     0.,     0.
 0.0024441,     0.,  2060., ,     0.,     0.
 0.0024441,    0.3,  2060., ,     0.,     0.
 0.0007078,     0.,    80., ,    0.2,     0.
 0.0007078,    0.3,    80., ,    0.2,     0.
  0.000994,     0.,   440., ,    0.2,     0.
  0.000994,    0.3,   440., ,    0.2,     0.
 0.0012471,     0.,   800., ,    0.2,     0.
 0.0012471,    0.3,   800., ,    0.2,     0.
 0.0014754,     0.,  1160., ,    0.2,     0.
 0.0014754,    0.3,  1160., ,    0.2,     0.
 0.0019864,     0.,  2060., ,    0.2,     0.
 0.0019864,    0.3,  2060., ,    0.2,     0.
 0.0005854,     0.,    80., ,    0.4,     0.
 0.0005854,    0.3,    80., ,    0.4,     0.
 0.0008124,     0.,   440., ,    0.4,     0.
 0.0008124,    0.3,   440., ,    0.4,     0.
 0.0010133,     0.,   800., ,    0.4,     0.
 0.0010133,    0.3,   800., ,    0.4,     0.
 0.0011912,     0.,  1160., ,    0.4,     0.
 0.0011912,    0.3,  1160., ,    0.4,     0.
 0.0015901,     0.,  2060., ,    0.4,     0.
 0.0015901,    0.3,  2060., ,    0.4,     0.
 0.0004703,     0.,    80., ,    0.6,     0.
 0.0004703,    0.3,    80., ,    0.6,     0.
 0.0006472,     0.,   440., ,    0.6,     0.
 0.0006472,    0.3,   440., ,    0.6,     0.
 0.0008043,     0.,   800., ,    0.6,     0.
 0.0008043,    0.3,   800., ,    0.6,     0.
 0.0009404,     0.,  1160., ,    0.6,     0.
 0.0009404,    0.3,  1160., ,    0.6,     0.
 0.0012488,     0.,  2060., ,    0.6,     0.
 0.0012488,    0.3,  2060., ,    0.6,     0.
 0.0003633,     0.,    80., ,    0.8,     0.
 0.0003633,    0.3,    80., ,    0.8,     0.
 0.0004979,     0.,   440., ,    0.8,     0.
 0.0004979,    0.3,   440., ,    0.8,     0.
 0.0006181,     0.,   800., ,    0.8,     0.
 0.0006181,    0.3,   800., ,    0.8,     0.
 0.0007192,     0.,  1160., ,    0.8,     0.
 0.0007192,    0.3,  1160., ,    0.8,     0.
  0.000954,     0.,  2060., ,    0.8,     0.
  0.000954,    0.3,  2060., ,    0.8,     0.
  0.000264,     0.,    80., ,     1.,     0.
  0.000264,    0.3,    80., ,     1.,     0.
 0.0003631,     0.,   440., ,     1.,     0.
 0.0003631,    0.3,   440., ,     1.,     0.
  0.000452,     0.,   800., ,     1.,     0.
  0.000452,    0.3,   800., ,     1.,     0.
 0.0005237,     0.,  1160., ,     1.,     0.
 0.0005237,    0.3,  1160., ,     1.,     0.
 0.0006978,     0.,  2060., ,     1.,     0.
 0.0006978,    0.3,  2060., ,     1.,     0.
 0.0003168,     0.,    80., ,     0.,   3.37
 0.0003168,    0.3,    80., ,     0.,   3.37
 0.0004515,     0.,   440., ,     0.,   3.37
 0.0004515,    0.3,   440., ,     0.,   3.37
 0.0005708,     0.,   800., ,     0.,   3.37
 0.0005708,    0.3,   800., ,     0.,   3.37
 0.0006803,     0.,  1160., ,     0.,   3.37
 0.0006803,    0.3,  1160., ,     0.,   3.37
 0.0009269,     0.,  2060., ,     0.,   3.37
 0.0009269,    0.3,  2060., ,     0.,   3.37
 0.0002684,     0.,    80., ,    0.2,   3.37
 0.0002684,    0.3,    80., ,    0.2,   3.37
  0.000377,     0.,   440., ,    0.2,   3.37
```

```
 0.000377,    0.3,   440., ,    0.2,   3.37
 0.000473,     0.,   800., ,    0.2,   3.37
 0.000473,    0.3,   800., ,    0.2,   3.37
0.0005595,     0.,  1160., ,    0.2,   3.37
0.0005595,    0.3,  1160., ,    0.2,   3.37
0.0007533,     0.,  2060., ,    0.2,   3.37
0.0007533,    0.3,  2060., ,    0.2,   3.37
 0.000222,     0.,    80., ,    0.4,   3.37
 0.000222,    0.3,    80., ,    0.4,   3.37
0.0003081,     0.,   440., ,    0.4,   3.37
0.0003081,    0.3,   440., ,    0.4,   3.37
0.0003843,     0.,   800., ,    0.4,   3.37
0.0003843,    0.3,   800., ,    0.4,   3.37
0.0004517,     0.,  1160., ,    0.4,   3.37
0.0004517,    0.3,  1160., ,    0.4,   3.37
 0.000603,     0.,  2060., ,    0.4,   3.37
 0.000603,    0.3,  2060., ,    0.4,   3.37
0.0001784,     0.,    80., ,    0.6,   3.37
0.0001784,    0.3,    80., ,    0.6,   3.37
0.0002455,     0.,   440., ,    0.6,   3.37
0.0002455,    0.3,   440., ,    0.6,   3.37
 0.000305,     0.,   800., ,    0.6,   3.37
 0.000305,    0.3,   800., ,    0.6,   3.37
0.0003566,     0.,  1160., ,    0.6,   3.37
0.0003566,    0.3,  1160., ,    0.6,   3.37
0.0004736,     0.,  2060., ,    0.6,   3.37
0.0004736,    0.3,  2060., ,    0.6,   3.37
0.0001378,     0.,    80., ,    0.8,   3.37
0.0001378,    0.3,    80., ,    0.8,   3.37
0.0001888,     0.,   440., ,    0.8,   3.37
0.0001888,    0.3,   440., ,    0.8,   3.37
0.0002344,     0.,   800., ,    0.8,   3.37
0.0002344,    0.3,   800., ,    0.8,   3.37
0.0002728,     0.,  1160., ,    0.8,   3.37
0.0002728,    0.3,  1160., ,    0.8,   3.37
0.0003618,     0.,  2060., ,    0.8,   3.37
0.0003618,    0.3,  2060., ,    0.8,   3.37
0.0001001,     0.,    80., ,     1.,   3.37
0.0001001,    0.3,    80., ,     1.,   3.37
0.0001377,     0.,   440., ,     1.,   3.37
0.0001377,    0.3,   440., ,     1.,   3.37
0.0001714,     0.,   800., ,     1.,   3.37
0.0001714,    0.3,   800., ,     1.,   3.37
0.0001986,     0.,  1160., ,     1.,   3.37
0.0001986,    0.3,  1160., ,     1.,   3.37
0.0002646,     0.,  2060., ,     1.,   3.37
0.0002646,    0.3,  2060., ,     1.,   3.37
0.0001201, 0.3003,  2060., ,     1.,   3.37
```

Capsule 6 Control Gas Gap

```
*Material, name=HE-NE_Control
*Conductivity, dependencies=2
 2.15e-06,  80.,   0.,    0.
 3.06e-06, 440.,   0.,    0.
 3.87e-06, 800.,   0.,    0.
 4.62e-06,1160.,   0.,    0.
 6.29e-06,2060.,   0.,    0.
 1.82e-06,  80.,  0.2,    0.
 2.56e-06, 440.,  0.2,    0.
 3.21e-06, 800.,  0.2,    0.
  3.8e-06,1160.,  0.2,    0.
 5.11e-06,2060.,  0.2,    0.
 1.51e-06,  80.,  0.4,    0.
 2.09e-06, 440.,  0.4,    0.
 2.61e-06, 800.,  0.4,    0.
 3.07e-06,1160.,  0.4,    0.
 4.09e-06,2060.,  0.4,    0.
 1.21e-06,  80.,  0.6,    0.
 1.67e-06, 440.,  0.6,    0.
 2.07e-06, 800.,  0.6,    0.
 2.42e-06,1160.,  0.6,    0.
 3.21e-06,2060.,  0.6,    0.
 9.35e-07,  80.,  0.8,    0.
 1.28e-06, 440.,  0.8,    0.
 1.59e-06, 800.,  0.8,    0.
 1.85e-06,1160.,  0.8,    0.
 2.45e-06,2060.,  0.8,    0.
 6.79e-07,  80.,   1.,    0.
 9.34e-07, 440.,   1.,    0.
 1.16e-06, 800.,   1.,    0.
 1.35e-06,1160.,   1.,    0.
  1.8e-06,2060.,   1.,    0.
 1.97e-06,  80.,   0., 2.56
 2.81e-06, 440.,   0., 2.56
 3.55e-06, 800.,   0., 2.56
 4.23e-06,1160.,   0., 2.56
 5.76e-06,2060.,   0., 2.56
 1.67e-06,  80.,  0.2, 2.56
 2.34e-06, 440.,  0.2, 2.56
 2.94e-06, 800.,  0.2, 2.56
 3.48e-06,1160.,  0.2, 2.56
 4.68e-06,2060.,  0.2, 2.56
 1.38e-06,  80.,  0.4, 2.56
 1.91e-06, 440.,  0.4, 2.56
 2.39e-06, 800.,  0.4, 2.56
 2.81e-06,1160.,  0.4, 2.56
 3.75e-06,2060.,  0.4, 2.56
 1.11e-06,  80.,  0.6, 2.56
 1.53e-06, 440.,  0.6, 2.56
  1.9e-06, 800.,  0.6, 2.56
 2.22e-06,1160.,  0.6, 2.56
 2.94e-06,2060.,  0.6, 2.56
 8.56e-07,  80.,  0.8, 2.56
 1.17e-06, 440.,  0.8, 2.56
 1.46e-06, 800.,  0.8, 2.56
 1.69e-06,1160.,  0.8, 2.56
 2.25e-06,2060.,  0.8, 2.56
 6.22e-07,  80.,   1., 2.56
 8.56e-07, 440.,   1., 2.56
 1.07e-06, 800.,   1., 2.56
 1.23e-06,1160.,   1., 2.56
 1.64e-06,2060.,   1., 2.56
```

Capsule 6 Compact – Graphite Holder Gap

```
*Gap Conductance, dependencies=2
 0.0008353,     0.,    80., ,     0.,     0.
 0.0008353,    0.3,    80., ,     0.,     0.
 0.0011905,     0.,   440., ,     0.,     0.
 0.0011905,    0.3,   440., ,     0.,     0.
 0.0015051,     0.,   800., ,     0.,     0.
 0.0015051,    0.3,   800., ,     0.,     0.
 0.0017939,     0.,  1160., ,     0.,     0.
 0.0017939,    0.3,  1160., ,     0.,     0.
 0.0024441,     0.,  2060., ,     0.,     0.
 0.0024441,    0.3,  2060., ,     0.,     0.
 0.0007078,     0.,    80., ,    0.2,     0.
 0.0007078,    0.3,    80., ,    0.2,     0.
  0.000994,     0.,   440., ,    0.2,     0.
  0.000994,    0.3,   440., ,    0.2,     0.
 0.0012471,     0.,   800., ,    0.2,     0.
 0.0012471,    0.3,   800., ,    0.2,     0.
 0.0014754,     0.,  1160., ,    0.2,     0.
 0.0014754,    0.3,  1160., ,    0.2,     0.
 0.0019864,     0.,  2060., ,    0.2,     0.
 0.0019864,    0.3,  2060., ,    0.2,     0.
 0.0005854,     0.,    80., ,    0.4,     0.
 0.0005854,    0.3,    80., ,    0.4,     0.
 0.0008124,     0.,   440., ,    0.4,     0.
 0.0008124,    0.3,   440., ,    0.4,     0.
 0.0010133,     0.,   800., ,    0.4,     0.
 0.0010133,    0.3,   800., ,    0.4,     0.
 0.0011912,     0.,  1160., ,    0.4,     0.
 0.0011912,    0.3,  1160., ,    0.4,     0.
 0.0015901,     0.,  2060., ,    0.4,     0.
 0.0015901,    0.3,  2060., ,    0.4,     0.
 0.0004703,     0.,    80., ,    0.6,     0.
 0.0004703,    0.3,    80., ,    0.6,     0.
 0.0006472,     0.,   440., ,    0.6,     0.
 0.0006472,    0.3,   440., ,    0.6,     0.
 0.0008043,     0.,   800., ,    0.6,     0.
 0.0008043,    0.3,   800., ,    0.6,     0.
 0.0009404,     0.,  1160., ,    0.6,     0.
 0.0009404,    0.3,  1160., ,    0.6,     0.
 0.0012488,     0.,  2060., ,    0.6,     0.
 0.0012488,    0.3,  2060., ,    0.6,     0.
 0.0003633,     0.,    80., ,    0.8,     0.
 0.0003633,    0.3,    80., ,    0.8,     0.
 0.0004979,     0.,   440., ,    0.8,     0.
 0.0004979,    0.3,   440., ,    0.8,     0.
 0.0006181,     0.,   800., ,    0.8,     0.
 0.0006181,    0.3,   800., ,    0.8,     0.
 0.0007192,     0.,  1160., ,    0.8,     0.
 0.0007192,    0.3,  1160., ,    0.8,     0.
  0.000954,     0.,  2060., ,    0.8,     0.
  0.000954,    0.3,  2060., ,    0.8,     0.
  0.000264,     0.,    80., ,     1.,     0.
  0.000264,    0.3,    80., ,     1.,     0.
 0.0003631,     0.,   440., ,     1.,     0.
 0.0003631,    0.3,   440., ,     1.,     0.
  0.000452,     0.,   800., ,     1.,     0.
  0.000452,    0.3,   800., ,     1.,     0.
 0.0005237,     0.,  1160., ,     1.,     0.
 0.0005237,    0.3,  1160., ,     1.,     0.
 0.0006978,     0.,  2060., ,     1.,     0.
 0.0006978,    0.3,  2060., ,     1.,     0.
 0.0006894,     0.,    80., ,     0.,   2.56
 0.0006894,    0.3,    80., ,     0.,   2.56
 0.0009826,     0.,   440., ,     0.,   2.56
 0.0009826,    0.3,   440., ,     0.,   2.56
 0.0012423,     0.,   800., ,     0.,   2.56
 0.0012423,    0.3,   800., ,     0.,   2.56
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0.0014808,     0.,  1160., ,     0.,   2.56
0.0014808,    0.3,  1160., ,     0.,   2.56
0.0020174,     0.,  2060., ,     0.,   2.56
0.0020174,    0.3,  2060., ,     0.,   2.56
0.0005842,     0.,    80., ,    0.2,   2.56
0.0005842,    0.3,    80., ,    0.2,   2.56
0.0008205,     0.,   440., ,    0.2,   2.56
0.0008205,    0.3,   440., ,    0.2,   2.56
0.0010294,     0.,   800., ,    0.2,   2.56
0.0010294,    0.3,   800., ,    0.2,   2.56
0.0012178,     0.,  1160., ,    0.2,   2.56
0.0012178,    0.3,  1160., ,    0.2,   2.56
0.0016396,     0.,  2060., ,    0.2,   2.56
0.0016396,    0.3,  2060., ,    0.2,   2.56
0.0004832,     0.,    80., ,    0.4,   2.56
0.0004832,    0.3,    80., ,    0.4,   2.56
0.0006705,     0.,   440., ,    0.4,   2.56
0.0006705,    0.3,   440., ,    0.4,   2.56
0.0008364,     0.,   800., ,    0.4,   2.56
0.0008364,    0.3,   800., ,    0.4,   2.56
0.0009832,     0.,  1160., ,    0.4,   2.56
0.0009832,    0.3,  1160., ,    0.4,   2.56
0.0013125,     0.,  2060., ,    0.4,   2.56
0.0013125,    0.3,  2060., ,    0.4,   2.56
0.0003882,     0.,    80., ,    0.6,   2.56
0.0003882,    0.3,    80., ,    0.6,   2.56
0.0005342,     0.,   440., ,    0.6,   2.56
0.0005342,    0.3,   440., ,    0.6,   2.56
0.0006639,     0.,   800., ,    0.6,   2.56
0.0006639,    0.3,   800., ,    0.6,   2.56
0.0007762,     0.,  1160., ,    0.6,   2.56
0.0007762,    0.3,  1160., ,    0.6,   2.56
0.0010308,     0.,  2060., ,    0.6,   2.56
0.0010308,    0.3,  2060., ,    0.6,   2.56
0.0002998,     0.,    80., ,    0.8,   2.56
0.0002998,    0.3,    80., ,    0.8,   2.56
 0.000411,     0.,   440., ,    0.8,   2.56
 0.000411,    0.3,   440., ,    0.8,   2.56
0.0005102,     0.,   800., ,    0.8,   2.56
0.0005102,    0.3,   800., ,    0.8,   2.56
0.0005937,     0.,  1160., ,    0.8,   2.56
0.0005937,    0.3,  1160., ,    0.8,   2.56
0.0007874,     0.,  2060., ,    0.8,   2.56
0.0007874,    0.3,  2060., ,    0.8,   2.56
0.0002179,     0.,    80., ,     1.,   2.56
0.0002179,    0.3,    80., ,     1.,   2.56
0.0002997,     0.,   440., ,     1.,   2.56
0.0002997,    0.3,   440., ,     1.,   2.56
0.0003731,     0.,   800., ,     1.,   2.56
0.0003731,    0.3,   800., ,     1.,   2.56
0.0004323,     0.,  1160., ,     1.,   2.56
0.0004323,    0.3,  1160., ,     1.,   2.56
 0.000576,     0.,  2060., ,     1.,   2.56
 0.000576,    0.3,  2060., ,     1.,   2.56
0.0005691, 0.3003,  2060., ,     1.,   2.56
```

Excerpt from letter from GrafTech International Ltd. providing properties for graphite used in holders (Thompson 2006).

GRAFTech
GrafTech International Ltd.

UCAR CARBON COMPANY INC., *a GrafTech International Ltd. company* *12900 Snow Road • Parma, Ohio 44130*

Tracy L. Thompson, Ph. D.
Staff Scientist

(216) 676-2307
Facsimile (216) 676-2276
tracy.thompson@graftech.com

July 13, 2006

To Whom it May Concern:

Please find the attached chemical and physical properties of the materials shipped per PO#00050342.

Physical Properties of Boronated Graphite*:

FO#	Density	WG Flexural Strength	AG Flexural Strength	WG Youngs Modulus	WG Specific Resistance	WG CTE (1" cube)	AG CTE (1" cube)	WG Thermal Conductivity	AG Thermal Conductivity
	g/cc	psi	psi	x 10^6 Psi	m ohm m	ppm/K	ppm/K	w/mK	w/mK
LP-61-6.2-2 (5.5% boron) (4 cores)	1.7	4470	4935	2.42	8.04	1.22	2.01	81.8	72.7
LP-61-7.9-1 (7.0% boron) (4 cores)	1.71	2215	2235	2.62	9.41	0.555	0.536	67.2	65

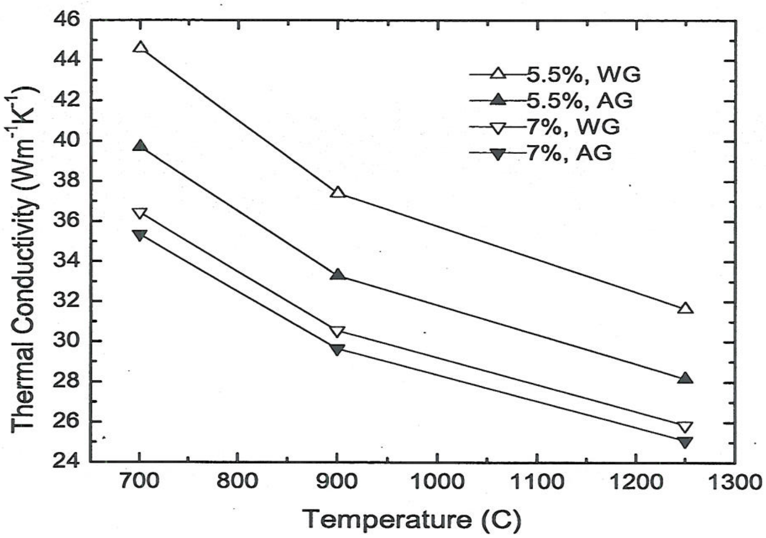
*All testing reported in this table was carried out a room temperature.

Physical Properties at Elevated Temperature (700-1300°C) :

	Core ID# LP61-6.2-2 (5.5% boron)	Core ID# LP61-7.9-1 (7% boron)
Unirradiated Thermal Conductivity (wg/ag)	See Chart Below	
Average Coefficient of Thermal Expansion (calculated) x ppm/°C	WG: 2.26 - 2.70 AG: 3.05 - 3.49	WG: 1.60 – 2.03 AG: 1.58 – 2.02
Average Specific Heat (700 – 1300 C) (J/kg-K) -	1807 @ 700 °C 2041 @ 1300 °C	1812 @ 700 °C 2048 @ 1300 °C

Continuation of letter from GrafTech by (Thompson 2006).

- **Unirradiated Thermal Conductivity (700-1300C)**



Elemental Analysis of Boronated Graphite:**

	Core ID# LP61-6.2-2 (5.5% boron) Concentration (ppm)	Core ID# LP61-7.9-1 (7% boron) Concentration (ppm)
Fe	270	350
V	33	8.4
Ti	10	10
Ca	350	160
Cr	<0.5	<0.5
Mn	3	4.4
Co	9.6	37
Ni	34	19
Al	43	92
Cl	5.9	8.4
Total Ash		

** Results obtained by GDMS analysis (Shiva Technologies).

Sterbentz E-mail communication to G. L. Hawkes concerning conversion of fluence to dpa for graphite.

Idaho National Laboratory

James W Sterbentz/BNZ/CC01/INEEL/US

08/05/2009 05:39 PM

To Grant L Hawkes/HAW/CC01/INEEL/US@INEL

cc Misti A Lillo/LILLMA/CC01/INEEL/US@INEL

bcc

Subject Fast Flux to DPA multiplier

History: This message has been replied to.

Grant,

The conversion factor for converting Misti's fast neutron fluence (neutrons/m2) greater than 0.18 MeV to dpa in graphite (borated graphite holders) is 8.23271E-26 which has units of (dpa/(n/m2)). Note the fast fluence value units are (neutrons per square **meter**).

The factor is virtually constant for all the borated graphite holder cells in the capsule--the fast fluence will of course vary from capsule to capsule because of the axial position in the ATR core and hence so will the capsule dpa.

This value checks out nicely with previously calculated dpa data.

Jim Sterbentz

APPENDIX C—Daily Gas Mixtures

Y = Mole Fraction

Grant placed 0.00 for these missing data

Year	Month	Day	Cycle	Sterbentz Time Step	Capsule 6 (Y Ne)	Capsule 5 (Y Ne)	Capsule 4 (Y Ne)	Capsule 3 (Y Ne)	Capsule 2 (Y Ne)	Capsule 1 (Y Ne)	Eff Power (MW)	Summation of Time at Temperature (Days)
2006	12	24	138B	01	0.000	0.000	0.000	0.000	0.000	0.000	1.82	0.38
2006	12	25	138B	02	0.000	0.058	0.034	0.059	0.049	0.024	5.23	1.38
2006	12	26	138B	03	0.002	0.011	0.002	0.020	0.003	0.010	20.16	2.38
2006	12	27	138B	04	0.000	0.008	0.004	0.014	0.007	0.000	21.72	3.38
2006	12	28	138B	05	0.000	0.000	0.000	0.006	0.001	0.000	21.75	4.38
2006	12	29	138B	06	0.002	0.001	0.000	0.003	0.003	0.000	21.67	5.38
2006	12	30	138B	07	0.002	0.001	0.000	0.003	0.002	0.000	21.90	6.38
2006	12	31	138B	08	0.002	0.001	0.000	0.003	0.002	0.000	22.02	7.38
2007	01	01	138B	09	0.002	0.001	0.000	0.003	0.002	0.000	22.16	8.38
2007	01	02	138B	10	0.001	0.001	0.000	0.001	0.001	0.000	22.24	9.38
2007	01	03	138B	11	0.000	0.000	0.000	0.000	0.000	0.000	22.20	10.38
2007	01	04	138B	12	0.000	0.000	0.000	0.000	0.000	0.000	22.34	11.38
2007	01	05	138B	13	0.000	0.000	0.000	0.000	0.000	0.000	22.13	12.38
2007	01	06	138B	14	0.000	0.000	0.000	0.000	0.000	0.000	22.41	13.38
2007	01	07	138B	15	0.000	0.000	0.000	0.000	0.000	0.000	22.36	14.38
2007	01	08	138B	16	0.000	0.000	0.000	0.000	0.000	0.000	22.34	15.38
2007	01	09	138B	17	0.000	0.000	0.000	0.000	0.000	0.000	22.06	16.38
2007	01	10	138B	18	0.000	0.000	0.000	0.000	0.000	0.000	22.01	17.38
2007	01	11	138B	19	0.000	0.000	0.000	0.000	0.000	0.000	22.06	18.38
2007	01	12	138B	20	0.000	0.000	0.000	0.000	0.000	0.000	22.04	19.38
2007	01	13	138B	21	0.000	0.000	0.000	0.000	0.000	0.000	22.14	20.38
2007	01	14	138B	22	0.000	0.000	0.000	0.000	0.000	0.000	22.02	21.38
2007	01	15	138B	23	0.000	0.000	0.000	0.000	0.000	0.000	22.12	22.38
2007	01	16	138B	24	0.000	0.000	0.000	0.000	0.000	0.000	22.16	23.38
2007	01	17	138B	25	0.000	0.000	0.000	0.000	0.000	0.000	22.08	24.38
2007	01	18	138B	26	0.000	0.000	0.000	0.000	0.000	0.000	22.06	25.38
2007	01	19	138B	27	0.000	0.000	0.000	0.000	0.000	0.000	22.18	26.38
2007	01	20	138B	28	0.000	0.000	0.000	0.000	0.000	0.000	22.23	27.38
2007	01	21	138B	29	0.000	0.000	0.000	0.000	0.000	0.000	22.26	28.38
2007	01	22	138B	30	0.000	0.000	0.000	0.000	0.000	0.000	22.42	29.38
2007	01	23	138B	31	0.000	0.000	0.000	0.000	0.000	0.000	22.39	30.38
2007	01	24	138B	32	0.000	0.000	0.000	0.000	0.000	0.000	22.40	31.38
2007	01	25	138B	33	0.000	0.000	0.000	0.000	0.000	0.000	22.31	32.38
2007	01	26	138B	34	0.000	0.000	0.000	0.000	0.000	0.000	22.40	33.38
2007	01	27	138B	35	0.000	0.000	0.000	0.000	0.000	0.000	22.30	34.38
2007	01	28	138B	36	0.000	0.000	0.000	0.000	0.000	0.000	22.29	35.38
2007	01	29	138B	37	0.000	0.000	0.000	0.000	0.000	0.000	22.55	36.38
2007	01	30	138B	38	0.000	0.000	0.000	0.000	0.000	0.000	22.56	37.38
2007	01	31	138B	39	0.000	0.000	0.000	0.000	0.000	0.000	22.47	38.38
2007	02	01	138B	40	0.000	0.000	0.000	0.000	0.000	0.000	22.67	39.38
2007	02	02	138B	41	0.000	0.000	0.000	0.000	0.000	0.000	22.67	40.38
2007	02	03	138B	42	0.000	0.000	0.000	0.000	0.000	0.000	22.71	41.38
2007	02	04	138B	43	0.000	0.000	0.000	0.000	0.000	0.000	22.71	42.38
2007	02	05	138B	44	0.000	0.000	0.000	0.000	0.000	0.000	22.94	43.38
2007	02	06	138B	45	0.000	0.000	0.000	0.000	0.000	0.000	22.79	44.38
2007	02	07	138B	46	0.000	0.000	0.000	0.000	0.000	0.000	22.49	45.38
2007	02	08	138B	47	0.000	0.000	0.000	0.000	0.000	0.000	22.46	46.38
2007	02	09	138B	48	0.000	0.000	0.000	0.000	0.000	0.000	22.41	47.38
2007	02	10	138B	49	0.000	0.000	0.000	0.000	0.000	0.000	22.57	47.75

Y = Mole Fraction

Grant placed 0.00 for these missing data

Redone to average only while reactor is at power

Year	Month	Day	Cycle	Sterbentz Time Step	Capsule 6 (Y Ne)	Capsule 5 (Y Ne)	Capsule 4 (Y Ne)	Capsule 3 (Y Ne)	Capsule 2 (Y Ne)	Capsule 1 (Y Ne)	Eff Power (MW)	Summation of Time at Temperature (Days)
2007	02	25	139A	01	0.000	0.000	0.000	0.000	0.000	0.000	6.53	48.08
2007	02	26	139A	02	0.000	0.000	0.000	0.000	0.000	0.000	21.75	49.08
2007	02	27	139A	03	0.000	0.000	0.000	0.000	0.000	0.000	22.32	50.08
2007	02	28	139A	04	0.000	0.000	0.000	0.000	0.000	0.000	22.52	51.08
2007	03	01	139A	05	0.000	0.000	0.000	0.000	0.000	0.000	22.56	52.08
2007	03	02	139A	06	0.000	0.000	0.000	0.000	0.000	0.000	22.67	53.08
2007	03	03	139A	07	0.000	0.000	0.000	0.000	0.000	0.000	22.56	54.08
2007	03	04	139A	08	0.000	0.041	0.000	0.000	0.000	0.000	22.74	55.08
2007	03	05	139A	09	0.040	0.105	0.122	0.115	0.121	0.125	22.72	56.08
2007	03	06	139A	10	0.835	0.827	0.961	0.921	0.952	0.989	22.60	57.08
2007	03	07	139A	11	0.841	0.827	0.960	0.919	0.949	0.985	22.58	58.08
2007	03	08	139A	12	0.843	0.827	0.961	0.919	0.948	0.984	22.60	59.08
2007	03	09	139A	13	0.844	0.828	0.961	0.919	0.948	0.984	22.62	60.08
2007	03	10	139A	14	0.844	0.827	0.960	0.918	0.947	0.984	22.51	61.08
2007	03	11	139A	15	0.845	0.827	0.960	0.917	0.946	0.983	22.68	62.08
2007	03	12	139A	16	0.844	0.827	0.959	0.916	0.945	0.982	22.70	63.08
2007	03	13	139A	17	0.844	0.827	0.959	0.916	0.945	0.983	22.63	64.08
2007	03	14	139A	18	0.844	0.828	0.960	0.918	0.946	0.985	22.61	65.08
2007	03	15	139A	19	0.845	0.829	0.960	0.918	0.946	0.984	22.71	66.08
2007	03	16	139A	20	0.846	0.829	0.959	0.917	0.943	0.982	22.83	67.08
2007	03	17	139A	21	0.843	0.828	0.958	0.917	0.943	0.983	22.84	68.08
2007	03	18	139A	22	0.841	0.828	0.958	0.917	0.943	0.984	22.76	69.08
2007	03	19	139A	23	0.515	0.497	0.577	0.541	0.548	0.572	22.76	70.08
2007	03	20	139A	24	0.000	0.000	0.000	0.000	0.000	0.000	0.00	70.08
2007	03	21	139A	25	0.000	0.000	0.000	0.000	0.000	0.000	0.00	70.08
2007	03	22	139A	26	0.272	0.258	0.304	0.282	0.285	0.297	19.90	71.08
2007	03	23	139A	27	0.843	0.832	0.967	0.920	0.944	0.994	22.70	72.08
2007	03	24	139A	28	0.844	0.831	0.968	0.920	0.942	0.993	22.55	73.08
2007	03	25	139A	29	0.843	0.831	0.968	0.919	0.941	0.993	22.72	74.08
2007	03	26	139A	30	0.842	0.831	0.968	0.919	0.940	0.993	22.57	75.08
2007	03	27	139A	31	0.841	0.830	0.967	0.920	0.940	0.993	22.49	76.08
2007	03	28	139A	32	0.841	0.831	0.967	0.922	0.941	0.995	22.60	77.08
2007	03	29	139A	33	0.841	0.832	0.968	0.923	0.943	0.998	22.72	78.08
2007	03	30	139A	34	0.839	0.832	0.969	0.924	0.944	0.998	22.88	79.08
2007	03	31	139A	35	0.838	0.832	0.969	0.925	0.943	0.998	22.69	80.08
2007	04	01	139A	36	0.838	0.831	0.968	0.926	0.943	0.998	22.64	81.08
2007	04	02	139A	37	0.839	0.831	0.969	0.928	0.943	0.998	22.64	82.08
2007	04	03	139A	38	0.840	0.832	0.971	0.929	0.944	0.999	22.58	83.08
2007	04	04	139A	39	0.841	0.831	0.970	0.928	0.941	0.996	22.60	84.08
2007	04	05	139A	40	0.839	0.831	0.970	0.928	0.941	0.943	22.70	85.08
2007	04	06	139A	41	0.837	0.831	0.970	0.929	0.942	0.895	22.49	86.08
2007	04	07	139A	42	0.838	0.831	0.970	0.928	0.941	0.918	22.48	87.08
2007	04	08	139A	43	0.838	0.830	0.969	0.928	0.940	0.925	22.49	88.08
2007	04	09	139A	44	0.838	0.830	0.894	0.907	0.940	0.865	22.44	89.08
2007	04	10	139A	45	0.840	0.832	0.867	0.899	0.941	0.837	22.58	90.08
2007	04	11	139A	46	0.839	0.831	0.868	0.898	0.941	0.837	22.56	91.08
2007	04	12	139A	47	0.840	0.831	0.894	0.907	0.941	0.865	22.81	92.08
2007	04	13	139A	48	0.839	0.831	0.970	0.933	0.942	0.892	22.76	93.08
2007	04	14	139A	49	0.838	0.831	0.970	0.933	0.941	0.874	22.84	94.08
2007	04	15	139A	50	0.838	0.831	0.969	0.932	0.940	0.881	23.01	95.08
2007	04	16	139A	51	0.839	0.831	0.970	0.932	0.939	0.903	23.12	96.08
2007	04	17	139A	52	0.839	0.830	0.970	0.933	0.939	0.895	23.03	97.08
2007	04	18	139A	53	0.839	0.830	0.970	0.933	0.940	0.867	22.80	98.08
2007	04	19	139A	54	0.634	0.635	0.743	0.711	0.747	0.668	22.80	99.08
2007	04	20	139A	55	0.840	0.826	0.970	0.934	0.942	0.831	22.74	100.08
2007	04	21	139A	56	0.573	0.549	0.677	0.628	0.621	0.571	22.63	100.46

Title: AGR-1 Daily As-run Thermal Analyses

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Y = Mole Fraction

Redone to average only while reactor is at power

Grant purposefully zeroed this value out

Year	Month	Day	Cycle	Sterbentz Time Step	Capsule 6 (Y Ne)	Capsule 5 (Y Ne)	Capsule 4 (Y Ne)	Capsule 3 (Y Ne)	Capsule 2 (Y Ne)	Capsule 1 (Y Ne)	Eff Power (MW)	Summation of Time at Temperature (Days)
2007	06	24	139B	01	0.000	0.000	0.000	0.000	0.000	0.000	6.71	100.79
2007	06	25	139B	02	0.000	0.000	0.000	0.000	0.000	0.000	20.30	101.79
2007	06	26	139B	03	0.000	0.000	0.000	0.000	0.000	0.000	20.85	102.79
2007	06	27	139B	04	0.000	0.000	0.000	0.000	0.000	0.000	21.27	103.79
2007	06	28	139B	05	0.492	0.484	0.562	0.541	0.541	0.571	21.35	104.79
2007	06	29	139B	06	0.827	0.806	0.948	0.918	0.919	0.960	21.72	105.79
2007	06	30	139B	07	0.826	0.806	0.948	0.918	0.917	0.959	21.58	106.79
2007	07	01	139B	08	0.825	0.806	0.948	0.918	0.916	0.959	21.60	107.79
2007	07	02	139B	09	0.825	0.805	0.947	0.919	0.915	0.959	21.67	108.79
2007	07	03	139B	10	0.823	0.805	0.947	0.918	0.915	0.959	21.66	109.79
2007	07	04	139B	11	0.823	0.805	0.946	0.917	0.913	0.957	21.71	110.79
2007	07	05	139B	12	0.822	0.804	0.946	0.915	0.910	0.957	21.50	111.79
2007	07	06	139B	13	0.821	0.805	0.946	0.915	0.909	0.958	21.36	112.79
2007	07	07	139B	14	0.820	0.804	0.946	0.914	0.908	0.959	21.43	113.79
2007	07	08	139B	15	0.820	0.804	0.945	0.913	0.907	0.960	21.47	114.79
2007	07	09	139B	16	0.820	0.805	0.946	0.913	0.907	0.961	21.47	115.79
2007	07	10	139B	17	0.820	0.805	0.946	0.912	0.906	0.960	21.40	116.79
2007	07	11	139B	18	0.820	0.806	0.946	0.911	0.905	0.961	21.60	117.79
2007	07	12	139B	19	0.820	0.806	0.945	0.910	0.904	0.963	21.58	118.79
2007	07	13	139B	20	0.821	0.806	0.945	0.909	0.903	0.963	21.64	119.79
2007	07	14	139B	21	0.820	0.806	0.945	0.909	0.902	0.963	21.66	120.79
2007	07	15	139B	22	0.820	0.806	0.945	0.909	0.902	0.963	21.52	121.79
2007	07	16	139B	23	0.821	0.806	0.945	0.909	0.902	0.963	21.85	122.79
2007	07	17	139B	24	0.820	0.805	0.945	0.908	0.901	0.963	21.78	123.79
2007	07	18	139B	25	0.821	0.806	0.946	0.908	0.902	0.963	21.84	124.79
2007	07	19	139B	26	0.822	0.807	0.947	0.909	0.902	0.963	21.73	125.79
2007	07	20	139B	27	0.822	0.807	0.948	0.910	0.903	0.962	21.73	126.79
2007	07	21	139B	28	0.822	0.807	0.948	0.910	0.903	0.962	21.75	127.79
2007	07	22	139B	29	0.822	0.807	0.948	0.910	0.903	0.962	21.74	128.79
2007	07	23	139B	30	0.822	0.806	0.947	0.908	0.901	0.962	21.69	129.79
2007	07	24	139B	31	0.818	0.806	0.945	0.904	0.898	0.963	21.70	130.79
2007	07	25	139B	32	0.820	0.808	0.946	0.905	0.899	0.963	21.86	131.79
2007	07	26	139B	33	0.317	0.390	0.391	0.384	0.388	0.407	21.81	132.08
2007	09	08	139B	34	0.000	0.000	0.000	0.000	0.000	0.000	0.00	132.08
2007	09	09	139B	35	0.000	0.000	0.000	0.000	0.000	0.000	0.38	132.63
2007	09	10	139B	36	0.501	0.492	0.576	0.543	0.540	0.567	18.85	133.63
2007	09	11	139B	37	0.851	0.836	0.982	0.930	0.933	0.951	21.64	134.63
2007	09	12	139B	38	0.850	0.835	0.981	0.928	0.930	0.946	21.70	135.63
2007	09	13	139B	39	0.849	0.834	0.980	0.927	0.928	0.945	21.52	136.63
2007	09	14	139B	40	0.847	0.835	0.980	0.926	0.927	0.945	21.46	137.63
2007	09	15	139B	41	0.848	0.834	0.980	0.925	0.926	0.926	21.51	138.63
2007	09	16	139B	42	0.847	0.835	0.980	0.926	0.926	0.905	21.67	139.63
2007	09	17	139B	43	0.847	0.835	0.979	0.925	0.925	0.908	21.72	140.63
2007	09	18	139B	44	0.847	0.834	0.979	0.925	0.925	0.878	21.61	141.63
2007	09	19	139B	45	0.846	0.835	0.981	0.926	0.926	0.864	21.66	142.63
2007	09	20	139B	46	0.846	0.834	0.981	0.925	0.925	0.866	21.69	143.63
2007	09	21	139B	47	0.848	0.834	0.981	0.925	0.914	0.855	21.70	144.63
2007	09	22	139B	48	0.847	0.835	0.981	0.924	0.889	0.825	21.66	145.63
2007	09	23	139B	49	0.518	0.508	0.590	0.556	0.527	0.488	21.42	146.63
2007	09	24	139B	50	0.647	0.676	0.841	0.761	0.708	0.564	21.12	147.63
2007	09	25	139B	51	0.615	0.662	0.858	0.770	0.684	0.283	21.12	148.63
2007	09	26	139B	52	0.597	0.626	0.835	0.737	0.642	0.000	21.19	149.63
2007	09	27	139B	53	0.558	0.554	0.750	0.669	0.560	0.000	20.99	150.63
2007	09	28	139B	54	0.518	0.504	0.691	0.614	0.503	0.000	21.07	151.63
2007	09	29	139B	55	0.422	0.411	0.563	0.497	0.406	0.000	20.89	152.50

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Year	Month	Day	Cycle	Sterbentz Time Step	Capsule 6 (Y Ne)	Capsule 5 (Y Ne)	Capsule 4 (Y Ne)	Capsule 3 (Y Ne)	Capsule 2 (Y Ne)	Capsule 1 (Y Ne)	Eff Power (MW)	Summation of Time at Temperature (Days)
2007	10	15	140A	01	0.000	0.000	0.000	0.000	0.000	0.000	5.49	152.83
2007	10	16	140A	02	0.399	0.366	0.421	0.400	0.397	0.000	19.88	153.83
2007	10	17	140A	03	0.867	0.759	0.887	0.833	0.840	0.447	21.65	154.83
2007	10	18	140A	04	0.853	0.745	0.884	0.826	0.831	0.803	21.50	155.83
2007	10	19	140A	05	0.851	0.743	0.881	0.822	0.828	0.802	21.38	156.83
2007	10	20	140A	06	0.852	0.745	0.883	0.824	0.829	0.804	21.53	157.83
2007	10	21	140A	07	0.853	0.746	0.884	0.825	0.829	0.807	21.38	158.83
2007	10	22	140A	08	0.853	0.745	0.883	0.823	0.828	0.806	21.30	159.83
2007	10	23	140A	09	0.853	0.744	0.883	0.821	0.827	0.807	21.29	160.83
2007	10	24	140A	10	0.854	0.743	0.882	0.820	0.826	0.807	20.96	161.83
2007	10	25	140A	11	0.851	0.744	0.882	0.820	0.827	0.807	21.00	162.83
2007	10	26	140A	12	0.849	0.746	0.883	0.821	0.828	0.808	21.10	163.83
2007	10	27	140A	13	0.850	0.746	0.884	0.822	0.828	0.810	21.05	164.83
2007	10	28	140A	14	0.849	0.745	0.883	0.820	0.827	0.809	21.07	165.83
2007	10	29	140A	15	0.848	0.744	0.882	0.819	0.826	0.809	21.15	166.83
2007	10	30	140A	16	0.848	0.744	0.882	0.818	0.826	0.809	21.07	167.83
2007	10	31	140A	17	0.850	0.743	0.883	0.819	0.828	0.811	21.09	168.83
2007	11	01	140A	18	0.851	0.743	0.883	0.819	0.828	0.811	20.96	169.83
2007	11	02	140A	19	0.851	0.743	0.884	0.820	0.829	0.812	20.95	170.83
2007	11	03	140A	20	0.848	0.746	0.886	0.822	0.832	0.812	20.88	171.83
2007	11	04	140A	21	0.841	0.822	0.960	0.907	0.912	0.809	21.08	172.83
2007	11	05	140A	22	0.842	0.821	0.962	0.910	0.912	0.870	20.94	173.83
2007	11	06	140A	23	0.841	0.819	0.963	0.909	0.919	0.930	21.01	174.83
2007	11	07	140A	24	0.843	0.817	0.963	0.908	0.937	0.930	21.06	175.83
2007	11	08	140A	25	0.846	0.817	0.963	0.910	0.939	0.930	20.96	176.83
2007	11	09	140A	26	0.837	0.828	0.962	0.909	0.936	0.930	20.85	177.83
2007	11	10	140A	27	0.837	0.848	0.960	0.907	0.934	0.930	20.88	178.83
2007	11	11	140A	28	0.840	0.847	0.959	0.906	0.935	0.930	20.80	179.83
2007	11	12	140A	29	0.838	0.849	0.959	0.907	0.935	0.930	20.97	180.83
2007	11	13	140A	30	0.836	0.850	0.959	0.907	0.936	0.930	21.02	181.83
2007	11	14	140A	31	0.840	0.850	0.961	0.908	0.938	0.930	20.93	182.83
2007	11	15	140A	32	0.840	0.848	0.960	0.907	0.937	0.930	20.86	183.83
2007	11	16	140A	33	0.834	0.849	0.958	0.906	0.936	0.930	20.99	184.83
2007	11	17	140A	34	0.836	0.847	0.957	0.905	0.935	0.930	20.97	185.83
2007	11	18	140A	35	0.835	0.847	0.956	0.905	0.937	0.930	21.04	186.83
2007	11	19	140A	36	0.837	0.843	0.958	0.907	0.939	0.930	21.08	187.83
2007	11	20	140A	37	0.839	0.843	0.959	0.909	0.940	0.930	20.83	188.83
2007	11	21	140A	38	0.836	0.845	0.959	0.911	0.941	0.930	20.86	189.83
2007	11	22	140A	39	0.837	0.845	0.959	0.910	0.941	0.930	20.82	190.83
2007	11	23	140A	40	0.836	0.845	0.958	0.910	0.940	0.930	20.95	191.83
2007	11	24	140A	41	0.845	0.841	0.958	0.907	0.938	0.930	20.87	192.83
2007	11	25	140A	42	0.841	0.843	0.958	0.908	0.939	0.930	20.98	193.83
2007	11	26	140A	43	0.841	0.843	0.958	0.908	0.939	0.930	20.99	194.83
2007	11	27	140A	44	0.845	0.840	0.957	0.906	0.938	0.930	20.93	195.83
2007	11	28	140A	45	0.842	0.842	0.958	0.907	0.939	0.930	20.96	196.83
2007	11	29	140A	46	0.843	0.841	0.957	0.906	0.938	0.930	20.95	197.83
2007	11	30	140A	47	0.845	0.839	0.957	0.905	0.937	0.930	20.97	198.83
2007	12	01	140A	48	0.640	0.624	0.715	0.667	0.688	0.685	20.86	199.29

Y = Mole Fraction

Grant placed 0.00 for these missing data

Grant had this data remain constant for the missing points

Year	Month	Day	Cycle	Sterbentz Time Step	Capsule 6 (Y Ne)	Capsule 5 (Y Ne)	Capsule 4 (Y Ne)	Capsule 3 (Y Ne)	Capsule 2 (Y Ne)	Capsule 1 (Y Ne)	Eff Power (MW)	Summation of Time at Temperature (Days)
2007	12	15	140B	01	0.000	0.000	0.000	0.000	0.000	0.000	0.31	199.63
2007	12	16	140B	02	0.825	0.314	0.711	0.597	0.807	0.548	14.62	200.63
2007	12	17	140B	03	0.825	0.314	0.711	0.597	0.807	0.548	20.28	201.63
2007	12	18	140B	04	0.825	0.314	0.711	0.597	0.807	0.548	20.46	202.63
2007	12	19	140B	05	0.825	0.314	0.711	0.597	0.807	0.548	20.27	203.63
2007	12	20	140B	06	0.825	0.314	0.711	0.597	0.807	0.548	20.30	204.63
2007	12	21	140B	07	0.830	0.314	0.711	0.597	0.807	0.548	20.25	205.63
2007	12	22	140B	08	0.817	0.299	0.699	0.587	0.791	0.548	20.10	206.63
2007	12	23	140B	09	0.821	0.301	0.708	0.602	0.794	0.548	20.29	207.63
2007	12	24	140B	10	0.864	0.347	0.760	0.663	0.855	0.546	20.39	208.63
2007	12	25	140B	11	0.866	0.347	0.761	0.663	0.856	0.547	20.46	209.63
2007	12	26	140B	12	0.866	0.347	0.761	0.663	0.855	0.548	20.40	210.63
2007	12	27	140B	13	0.866	0.347	0.761	0.663	0.852	0.548	20.32	211.63
2007	12	28	140B	14	0.866	0.347	0.760	0.662	0.848	0.548	20.33	212.63
2007	12	29	140B	15	0.867	0.347	0.761	0.662	0.849	0.547	20.31	213.63
2007	12	30	140B	16	0.868	0.347	0.761	0.662	0.849	0.548	20.20	214.63
2007	12	31	140B	17	0.854	0.344	0.756	0.659	0.846	0.549	20.15	215.63
2008	01	01	140B	18	0.811	0.312	0.721	0.627	0.815	0.548	20.18	216.63
2008	01	02	140B	19	0.820	0.301	0.714	0.617	0.816	0.548	20.22	217.63
2008	01	03	140B	20	0.792	0.300	0.715	0.616	0.817	0.548	20.13	218.63
2008	01	04	140B	21	0.786	0.290	0.706	0.607	0.807	0.548	19.98	219.63
2008	01	05	140B	22	0.779	0.256	0.682	0.585	0.782	0.549	20.17	220.63
2008	01	06	140B	23	0.777	0.232	0.668	0.578	0.772	0.550	20.11	221.63
2008	01	07	140B	24	0.755	0.226	0.648	0.556	0.748	0.544	20.05	222.63
2008	01	08	140B	25	0.734	0.220	0.632	0.540	0.731	0.546	20.06	223.63
2008	01	09	140B	26	0.449	0.133	0.382	0.324	0.427	0.331	20.45	224.42
2008	01	10	140B	27	0.000	0.000	0.000	0.000	0.000	0.000	0.00	224.42
2008	01	15	140B	28	0.424	0.156	0.410	0.371	0.457	0.434	10.08	225.00
2008	01	16	140B	29	0.556	0.096	0.470	0.397	0.594	0.550	21.85	226.00
2008	01	17	140B	30	0.564	0.085	0.467	0.394	0.591	0.550	21.94	227.00
2008	01	18	140B	31	0.566	0.088	0.474	0.401	0.595	0.550	21.78	228.00
2008	01	19	140B	32	0.589	0.110	0.506	0.431	0.619	0.550	21.88	229.00
2008	01	20	140B	33	0.562	0.088	0.481	0.411	0.593	0.550	21.90	230.00
2008	01	21	140B	34	0.537	0.074	0.469	0.403	0.587	0.550	22.04	231.00
2008	01	22	140B	35	0.534	0.077	0.480	0.416	0.599	0.550	22.21	232.00
2008	01	23	140B	36	0.562	0.097	0.511	0.443	0.625	0.550	22.08	233.00
2008	01	24	140B	37	0.526	0.073	0.485	0.418	0.597	0.550	22.11	234.00
2008	01	25	140B	38	0.483	0.037	0.440	0.374	0.550	0.550	22.06	235.00
2008	01	26	140B	39	0.179	0.000	0.152	0.119	0.185	0.210	20.36	235.54

Grant purposefully zeroed this value out

No data, Grant averaged from before and after in Sterbentz's spreadsh

Y = Mole Fraction

Missing Data Input from "Missing Data" Spreadsheet from Abbott

Year	Month	Day	Cycle	Sterbentz Time Step	Capsule 6 (Y Ne)	Capsule 5 (Y Ne)	Capsule 4 (Y Ne)	Capsule 3 (Y Ne)	Capsule 2 (Y Ne)	Capsule 1 (Y Ne)	Eff Power (MW)	Summation of Time at Temperature (Days)
2008	02	04	141A	01	0.000	0.000	0.000	0.000	0.000	0.000	9.68	235.88
2008	02	05	141A	02	0.406	0.123	0.354	0.311	0.407	0.274	21.45	236.88
2008	02	06	141A	03	0.663	0.177	0.594	0.549	0.740	0.550	21.31	237.88
2008	02	07	141A	04	0.575	0.211	0.529	0.493	0.628	0.419	21.90	238.88
2008	02	08	141A	05	0.740	0.253	0.677	0.642	0.816	0.550	21.77	239.88
2008	02	09	141A	06	0.704	0.221	0.638	0.603	0.778	0.550	21.68	240.88
2008	02	10	141A	07	0.697	0.214	0.632	0.594	0.773	0.550	22.03	241.88
2008	02	11	141A	08	0.697	0.213	0.636	0.597	0.773	0.550	22.04	242.88
2008	02	12	141A	09	0.651	0.178	0.592	0.558	0.721	0.550	22.04	243.88
2008	02	13	141A	10	0.631	0.159	0.571	0.539	0.700	0.550	22.10	244.88
2008	02	14	141A	11	0.478	0.138	0.497	0.475	0.534	0.490	22.13	245.88
2008	02	15	141A	12	0.411	0.128	0.465	0.448	0.459	0.473	22.08	246.88
2008	02	16	141A	13	0.410	0.125	0.465	0.447	0.458	0.473	22.15	247.88
2008	02	17	141A	14	0.408	0.092	0.456	0.439	0.459	0.479	21.70	248.88
2008	02	18	141A	15	0.407	0.064	0.430	0.416	0.468	0.483	21.64	249.88
2008	02	19	141A	16	0.407	0.049	0.437	0.414	0.460	0.483	22.09	250.88
2008	02	20	141A	17	0.406	0.060	0.455	0.434	0.459	0.483	22.09	251.88
2008	02	21	141A	18	0.406	0.060	0.456	0.434	0.459	0.483	22.08	252.88
2008	02	22	141A	19	0.474	0.097	0.500	0.485	0.537	0.496	22.25	253.88
2008	02	23	141A	20	0.621	0.174	0.611	0.613	0.734	0.550	22.05	254.88
2008	02	24	141A	21	0.613	0.170	0.602	0.600	0.708	0.550	22.23	255.88
2008	02	25	141A	22	0.523	0.140	0.539	0.528	0.599	0.528	22.22	256.88
2008	02	26	141A	23	0.428	0.100	0.488	0.449	0.467	0.493	22.11	257.88
2008	02	27	141A	24	0.428	0.094	0.487	0.448	0.465	0.493	22.26	258.88
2008	02	28	141A	25	0.429	0.067	0.463	0.450	0.467	0.493	22.30	259.88
2008	02	29	141A	26	0.428	0.045	0.442	0.448	0.468	0.493	22.13	260.88
2008	03	01	141A	27	0.424	0.013	0.399	0.411	0.469	0.493	22.06	261.88
2008	03	02	141A	28	0.418	0.007	0.397	0.409	0.470	0.493	22.07	262.88
2008	03	03	141A	29	0.430	0.052	0.455	0.451	0.466	0.493	22.01	263.88
2008	03	04	141A	30	0.439	0.039	0.458	0.455	0.469	0.500	22.13	264.88
2008	03	05	141A	31	0.436	0.053	0.467	0.455	0.469	0.500	22.21	265.88
2008	03	06	141A	32	0.436	0.053	0.467	0.455	0.469	0.500	22.13	266.88
2008	03	07	141A	33	0.433	0.072	0.492	0.455	0.469	0.500	22.16	267.88
2008	03	08	141A	34	0.359	0.067	0.417	0.379	0.389	0.488	22.05	268.17

Y = Mole Fraction

Grant purposefully zeroed this value out

Redone to average only while reactor is at power

Year	Month	Day	Cycle	Sterbentz Time Step	Capsule 6 (Y Ne)	Capsule 5 (Y Ne)	Capsule 4 (Y Ne)	Capsule 3 (Y Ne)	Capsule 2 (Y Ne)	Capsule 1 (Y Ne)	Eff Power (MW)	Summation of Time at Temperature (Days)
2008	05	02	142A	01	0.000	0.000	0.000	0.000	0.000	0.000	7.92	268.50
2008	05	03	142A	02	0.893	0.897	0.604	0.952	0.000	0.000	22.33	269.50
2008	05	04	142A	03	0.891	0.897	0.538	0.950	0.000	0.000	22.38	270.50
2008	05	05	142A	04	0.883	0.869	0.534	0.581	0.000	0.000	21.97	271.50
2008	05	06	142A	05	0.873	0.842	0.531	0.145	0.151	0.165	21.86	272.50
2008	05	07	142A	06	0.845	0.801	0.524	0.438	0.456	0.500	21.88	273.50
2008	05	08	142A	07	0.699	0.714	0.459	0.417	0.427	0.470	21.88	274.54
2008	05	09	142A	08	0.744	0.776	0.482	0.436	0.447	0.493	21.93	275.54
2008	05	10	142A	09	0.744	0.776	0.482	0.436	0.447	0.493	21.95	276.54
2008	05	11	142A	10	0.742	0.775	0.482	0.435	0.446	0.493	22.14	277.54
2008	05	12	142A	11	0.742	0.776	0.482	0.436	0.446	0.493	22.03	278.54
2008	05	13	142A	12	0.742	0.776	0.482	0.436	0.447	0.493	21.88	279.54
2008	05	14	142A	13	0.743	0.775	0.481	0.436	0.448	0.493	21.82	280.54
2008	05	15	142A	14	0.742	0.775	0.481	0.436	0.448	0.493	21.81	281.54
2008	05	16	142A	15	0.753	0.773	0.657	0.435	0.447	0.493	21.96	282.54
2008	05	17	142A	16	0.758	0.772	0.778	0.435	0.446	0.493	21.85	283.54
2008	05	18	142A	17	0.785	0.801	0.834	0.435	0.446	0.493	22.05	284.54
2008	05	19	142A	18	0.805	0.820	0.857	0.434	0.446	0.493	22.18	285.54
2008	05	20	142A	19	0.805	0.820	0.853	0.433	0.446	0.493	22.07	286.54
2008	05	21	142A	20	0.844	0.833	0.916	0.433	0.445	0.493	22.00	287.54
2008	05	22	142A	21	0.844	0.831	0.894	0.433	0.445	0.493	22.01	288.54
2008	05	23	142A	22	0.844	0.831	0.894	0.433	0.446	0.493	21.96	289.54
2008	05	24	142A	23	0.861	0.852	0.927	0.434	0.446	0.493	22.04	290.54
2008	05	25	142A	24	0.864	0.855	0.919	0.433	0.446	0.493	22.17	291.54
2008	05	26	142A	25	0.863	0.855	0.916	0.433	0.446	0.493	22.26	292.54
2008	05	27	142A	26	0.864	0.855	0.891	0.433	0.446	0.493	22.34	293.54
2008	05	28	142A	27	0.864	0.855	0.816	0.433	0.446	0.493	22.23	294.54
2008	05	29	142A	28	0.864	0.844	0.824	0.433	0.447	0.493	22.20	295.54
2008	05	30	142A	29	0.863	0.801	0.752	0.433	0.446	0.493	22.32	296.54
2008	05	31	142A	30	0.863	0.787	0.493	0.433	0.446	0.493	22.48	297.54
2008	06	01	142A	31	0.865	0.744	0.492	0.433	0.447	0.493	22.57	298.58
2008	06	02	142A	32	0.866	0.733	0.493	0.434	0.447	0.493	22.59	299.58
2008	06	03	142A	33	0.746	0.627	0.422	0.371	0.381	0.421	20.25	300.42
2008	06	04	142A	34	0.000	0.000	0.000	0.000	0.000	0.000	0.00	300.42
2008	06	05	142A	35	0.120	0.115	0.130	0.119	0.120	0.133	18.21	300.88
2008	06	06	142A	36	0.872	0.781	0.490	0.437	0.457	0.500	22.57	301.88
2008	06	07	142A	37	0.873	0.758	0.490	0.438	0.458	0.500	22.35	302.88
2008	06	08	142A	38	0.874	0.733	0.490	0.438	0.458	0.500	22.40	303.88
2008	06	09	142A	39	0.874	0.709	0.490	0.438	0.457	0.500	22.53	304.88
2008	06	10	142A	40	0.874	0.706	0.490	0.438	0.458	0.500	22.45	305.88
2008	06	11	142A	41	0.874	0.739	0.490	0.438	0.458	0.500	22.56	306.88
2008	06	12	142A	42	0.874	0.714	0.490	0.438	0.458	0.500	22.61	307.88
2008	06	13	142A	43	0.858	0.763	0.490	0.438	0.457	0.500	22.56	308.88
2008	06	14	142A	44	0.872	0.820	0.490	0.437	0.456	0.500	22.57	309.88
2008	06	15	142A	45	0.870	0.820	0.490	0.436	0.456	0.500	22.52	310.88
2008	06	16	142A	46	0.870	0.811	0.489	0.436	0.455	0.500	22.51	311.88
2008	06	17	142A	47	0.871	0.768	0.490	0.436	0.456	0.500	22.61	312.88
2008	06	18	142A	48	0.872	0.760	0.490	0.436	0.456	0.500	22.54	313.88
2008	06	19	142A	49	0.868	0.754	0.490	0.437	0.456	0.500	22.49	314.88
2008	06	20	142A	50	0.855	0.741	0.490	0.436	0.456	0.500	22.60	315.88
2008	06	21	142A	51	0.662	0.561	0.367	0.326	0.339	0.372	22.76	316.50

Title: AGR-1 Daily As-run Thermal Analyses

ECAR No.: 968 ECAR Rev. No.: 2 Project File No.: 23843 Date: 01/25/2012

Y = Mole Fraction

Grant purposefully zeroed this value out

Redone to average only while reactor is at power

Year	Month	Day	Cycle	Sterbentz Time Step	Capsule 6 (Y Ne)	Capsule 5 (Y Ne)	Capsule 4 (Y Ne)	Capsule 3 (Y Ne)	Capsule 2 (Y Ne)	Capsule 1 (Y Ne)	Eff Power (MW)	Summation of Time at Temperature (Days)
2008	07	04	142B	01	0.000	0.000	0.000	0.000	0.000	0.000	7.64	316.83
2008	07	05	142B	02	0.000	0.000	0.000	0.000	0.000	0.000	20.58	317.83
2008	07	06	142B	03	0.000	0.000	0.000	0.000	0.000	0.000	2.83	317.83
2008	07	07	142B	04	0.000	0.000	0.000	0.000	0.000	0.000	0.00	317.83
2008	07	08	142B	05	0.000	0.000	0.000	0.000	0.000	0.000	15.96	318.38
2008	07	09	142B	06	0.445	0.411	0.307	0.276	0.286	0.313	23.54	319.38
2008	07	10	142B	07	0.778	0.718	0.489	0.437	0.457	0.500	23.25	320.38
2008	07	11	142B	08	0.877	0.767	0.489	0.437	0.456	0.500	23.07	321.38
2008	07	12	142B	09	0.878	0.795	0.647	0.437	0.456	0.500	23.11	322.38
2008	07	13	142B	10	0.877	0.824	0.701	0.436	0.455	0.500	23.06	323.38
2008	07	14	142B	11	0.877	0.813	0.701	0.436	0.455	0.500	23.11	324.38
2008	07	15	142B	12	0.876	0.783	0.672	0.435	0.455	0.500	23.21	325.38
2008	07	16	142B	13	0.876	0.764	0.618	0.450	0.470	0.500	23.08	326.38
2008	07	17	142B	14	0.874	0.752	0.545	0.492	0.514	0.500	22.91	327.38
2008	07	18	142B	15	0.875	0.752	0.581	0.513	0.535	0.500	23.31	328.38
2008	07	19	142B	16	0.876	0.754	0.634	0.544	0.567	0.500	23.45	329.38
2008	07	20	142B	17	0.874	0.753	0.633	0.543	0.566	0.500	23.56	330.38
2008	07	21	142B	18	0.873	0.752	0.632	0.542	0.565	0.500	23.42	331.38
2008	07	22	142B	19	0.872	0.752	0.632	0.541	0.565	0.500	23.22	332.38
2008	07	23	142B	20	0.875	0.753	0.633	0.542	0.566	0.500	23.19	333.38
2008	07	24	142B	21	0.876	0.753	0.634	0.543	0.566	0.500	23.18	334.38
2008	07	25	142B	22	0.875	0.753	0.633	0.542	0.566	0.500	23.16	335.38
2008	07	26	142B	23	0.875	0.753	0.634	0.542	0.566	0.500	23.17	336.38
2008	07	27	142B	24	0.877	0.763	0.644	0.549	0.567	0.500	23.39	337.38
2008	07	28	142B	25	0.877	0.761	0.637	0.544	0.567	0.500	23.25	338.38
2008	07	29	142B	26	0.877	0.761	0.677	0.543	0.566	0.500	23.29	339.38
2008	07	30	142B	27	0.877	0.757	0.720	0.542	0.566	0.500	23.21	340.38
2008	07	31	142B	28	0.876	0.750	0.745	0.603	0.629	0.500	23.34	341.38
2008	08	01	142B	29	0.874	0.747	0.758	0.675	0.705	0.500	23.36	342.38
2008	08	02	142B	30	0.874	0.747	0.756	0.675	0.705	0.500	23.31	343.38
2008	08	03	142B	31	0.874	0.747	0.748	0.669	0.700	0.500	23.14	344.38
2008	08	04	142B	32	0.826	0.765	0.653	0.574	0.600	0.470	22.98	345.67
2008	08	07	142B	33	0.000	0.000	0.000	0.000	0.000	0.000	0.00	345.67
2008	08	07	142B	34	0.000	0.000	0.000	0.000	0.000	0.000	20.73	346.13
2008	08	08	142B	35	0.731	0.665	0.713	0.465	0.485	0.319	23.46	347.13
2008	08	09	142B	36	0.880	0.825	0.828	0.745	0.781	0.500	23.09	348.13
2008	08	10	142B	37	0.882	0.842	0.820	0.733	0.767	0.500	22.93	349.13
2008	08	11	142B	38	0.882	0.842	0.787	0.727	0.761	0.500	22.89	350.13
2008	08	12	142B	39	0.880	0.844	0.738	0.666	0.695	0.500	22.88	351.13
2008	08	13	142B	40	0.879	0.843	0.724	0.664	0.694	0.500	22.85	352.13
2008	08	14	142B	41	0.879	0.841	0.735	0.655	0.687	0.500	23.12	353.13
2008	08	15	142B	42	0.880	0.818	0.715	0.636	0.669	0.500	23.07	354.13
2008	08	16	142B	43	0.881	0.783	0.680	0.608	0.637	0.500	22.91	355.13
2008	08	17	142B	44	0.883	0.801	0.757	0.675	0.709	0.502	23.37	356.13
2008	08	18	142B	45	0.880	0.840	0.823	0.737	0.772	0.500	23.30	357.13
2008	08	19	142B	46	0.879	0.840	0.804	0.728	0.763	0.500	23.51	358.13
2008	08	20	142B	47	0.878	0.842	0.758	0.678	0.710	0.500	23.40	359.13
2008	08	21	142B	48	0.878	0.781	0.710	0.637	0.668	0.500	23.30	360.13
2008	08	22	142B	49	0.836	0.735	0.664	0.596	0.624	0.500	23.22	361.13
2008	08	23	142B	50	0.754	0.671	0.612	0.548	0.571	0.500	23.25	362.13
2008	08	24	142B	51	0.731	0.666	0.610	0.545	0.571	0.500	23.30	363.13
2008	08	25	142B	52	0.826	0.755	0.691	0.621	0.651	0.500	23.22	364.13
2008	08	26	142B	53	0.842	0.784	0.744	0.682	0.710	0.497	23.54	365.13
2008	08	27	142B	54	0.880	0.840	0.782	0.701	0.736	0.497	23.94	366.13
2008	08	28	142B	55	0.852	0.792	0.747	0.672	0.705	0.497	23.87	367.13
2008	08	29	142B	56	0.806	0.739	0.696	0.625	0.657	0.497	23.68	368.13
2008	08	30	142B	57	0.680	0.637	0.585	0.528	0.549	0.438	23.72	369.00

Y = Mole Fraction

Grant purposefully zeroed this value out

Redone to average only while reactor is at power

Year	Month	Day	Cycle	Sterbentz Time Step	Capsule 6 (Y Ne)	Capsule 5 (Y Ne)	Capsule 4 (Y Ne)	Capsule 3 (Y Ne)	Capsule 2 (Y Ne)	Capsule 1 (Y Ne)	Eff Power (MW)	Summation of Time at Temperature (Days)
2008	09	23	143A	01	0.000	0.000	0.000	0.000	0.000	0.000	13.54	369.33
2008	09	24	143A	02	0.328	0.297	0.260	0.098	0.102	0.083	22.09	370.33
2008	09	25	143A	03	0.892	0.791	0.682	0.621	0.652	0.493	22.48	371.33
2008	09	26	143A	04	0.891	0.792	0.683	0.620	0.651	0.493	22.59	372.33
2008	09	27	143A	05	0.890	0.793	0.686	0.622	0.652	0.493	22.67	373.33
2008	09	28	143A	06	0.887	0.790	0.786	0.709	0.745	0.493	22.74	374.33
2008	09	29	143A	07	0.886	0.790	0.789	0.712	0.748	0.493	22.62	375.33
2008	09	30	143A	08	0.886	0.796	0.789	0.709	0.746	0.493	22.61	376.33
2008	10	01	143A	09	0.885	0.806	0.836	0.744	0.785	0.493	22.53	377.33
2008	10	02	143A	10	0.885	0.806	0.836	0.744	0.784	0.493	22.59	378.33
2008	10	03	143A	11	0.884	0.805	0.818	0.732	0.771	0.493	22.40	379.33
2008	10	04	143A	12	0.884	0.805	0.814	0.730	0.767	0.493	22.33	380.33
2008	10	05	143A	13	0.885	0.806	0.814	0.731	0.769	0.493	22.26	381.33
2008	10	06	143A	14	0.885	0.806	0.805	0.732	0.769	0.493	22.26	382.33
2008	10	07	143A	15	0.885	0.807	0.757	0.688	0.724	0.493	22.30	383.33
2008	10	08	143A	16	0.886	0.808	0.745	0.674	0.709	0.493	22.29	384.33
2008	10	09	143A	17	0.887	0.798	0.727	0.653	0.687	0.493	22.24	385.33
2008	10	10	143A	18	0.886	0.808	0.779	0.694	0.731	0.493	22.23	386.33
2008	10	11	143A	19	0.883	0.836	0.808	0.722	0.761	0.493	22.31	387.33
2008	10	12	143A	20	0.882	0.825	0.788	0.704	0.742	0.493	22.29	388.33
2008	10	13	143A	21	0.883	0.805	0.751	0.672	0.710	0.493	22.35	389.33
2008	10	14	143A	22	0.863	0.755	0.716	0.643	0.681	0.493	22.41	390.33
2008	10	15	143A	23	0.851	0.759	0.728	0.654	0.692	0.493	22.33	391.33
2008	10	16	143A	24	0.785	0.709	0.700	0.622	0.655	0.432	22.52	391.96
2008	11	04	143A	25	0.000	0.000	0.000	0.000	0.000	0.000	0.00	391.96
2008	11	05	143A	26	0.376	0.343	0.357	0.321	0.335	0.219	19.21	392.96
2008	11	06	143A	27	0.890	0.829	0.788	0.704	0.747	0.500	22.46	393.96
2008	11	07	143A	28	0.887	0.829	0.770	0.685	0.727	0.500	22.55	394.96
2008	11	08	143A	29	0.859	0.800	0.751	0.677	0.718	0.500	22.49	395.96
2008	11	09	143A	30	0.812	0.763	0.723	0.658	0.698	0.500	22.47	396.96
2008	11	10	143A	31	0.798	0.743	0.693	0.616	0.657	0.500	22.56	397.96
2008	11	11	143A	32	0.816	0.752	0.705	0.618	0.659	0.500	22.60	398.96
2008	11	12	143A	33	0.787	0.741	0.694	0.620	0.658	0.500	22.64	399.96
2008	11	13	143A	34	0.791	0.746	0.709	0.629	0.664	0.500	22.73	400.96
2008	11	14	143A	35	0.834	0.787	0.742	0.661	0.697	0.500	22.70	401.96
2008	11	15	143A	36	0.830	0.785	0.740	0.659	0.695	0.500	22.72	402.96
2008	11	16	143A	37	0.791	0.759	0.721	0.642	0.677	0.500	22.73	403.96
2008	11	17	143A	38	0.781	0.750	0.718	0.641	0.676	0.500	22.72	404.96
2008	11	18	143A	39	0.738	0.714	0.682	0.608	0.641	0.628	22.74	405.96
2008	11	19	143A	40	0.797	0.771	0.737	0.656	0.693	0.700	22.65	406.96
2008	11	20	143A	41	0.718	0.701	0.674	0.612	0.644	0.674	22.19	408.13
2008	11	25	143A	42	0.000	0.000	0.000	0.000	0.000	0.000	0.00	408.13
2008	11	26	143A	43	0.028	0.025	0.029	0.028	0.026	0.031	15.56	408.46
2008	11	27	143A	44	0.705	0.707	0.663	0.580	0.615	0.700	22.92	409.46
2008	11	28	143A	45	0.682	0.687	0.641	0.572	0.602	0.700	23.07	410.46
2008	11	29	143A	46	0.723	0.730	0.688	0.612	0.645	0.700	23.05	411.46
2008	11	30	143A	47	0.738	0.751	0.725	0.644	0.680	0.700	22.87	412.46
2008	12	01	143A	48	0.708	0.725	0.707	0.630	0.665	0.700	22.72	413.46
2008	12	02	143A	49	0.699	0.732	0.717	0.641	0.677	0.700	22.92	414.46
2008	12	03	143A	50	0.657	0.694	0.682	0.628	0.663	0.700	22.90	415.46
2008	12	04	143A	51	0.666	0.708	0.706	0.629	0.664	0.700	22.84	416.46
2008	12	05	143A	52	0.654	0.707	0.702	0.626	0.660	0.700	22.87	417.46
2008	12	06	143A	53	0.550	0.595	0.593	0.529	0.556	0.583	22.83	418.38

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Redone to average only while reactor is at power

Year	Month	Day	Cycle	Sterbentz Time Step	Capsule 6 (Y Ne)	Capsule 5 (Y Ne)	Capsule 4 (Y Ne)	Capsule 3 (Y Ne)	Capsule 2 (Y Ne)	Capsule 1 (Y Ne)	Eff Power (MW)	Summation of Time at Temperature (Days)
2008	12	22	143B	01	0.000	0.000	0.000	0.000	0.000	0.000	0.26	418.71
2008	12	23	143B	02	0.071	0.064	0.076	0.069	0.069	0.077	12.15	419.71
2008	12	24	143B	03	0.869	0.813	0.851	0.758	0.804	0.864	22.89	420.71
2008	12	25	143B	04	0.874	0.826	0.807	0.716	0.759	0.821	22.91	421.71
2008	12	26	143B	05	0.874	0.830	0.797	0.706	0.748	0.809	22.70	422.71
2008	12	27	143B	06	0.873	0.827	0.798	0.704	0.747	0.782	22.82	423.71
2008	12	28	143B	07	0.873	0.833	0.813	0.715	0.762	0.702	22.99	424.71
2008	12	29	143B	08	0.862	0.822	0.800	0.705	0.753	0.702	22.92	425.71
2008	12	30	143B	09	0.872	0.831	0.818	0.723	0.768	0.702	23.12	426.71
2008	12	31	143B	10	0.870	0.831	0.818	0.722	0.767	0.702	23.11	427.71
2009	01	01	143B	11	0.867	0.828	0.817	0.720	0.767	0.702	23.04	428.71
2009	01	02	143B	12	0.867	0.828	0.813	0.719	0.766	0.702	22.95	429.71
2009	01	03	143B	13	0.826	0.799	0.787	0.693	0.738	0.703	22.85	430.71
2009	01	04	143B	14	0.828	0.795	0.805	0.711	0.756	0.698	22.81	431.71
2009	01	05	143B	15	0.855	0.816	0.881	0.772	0.820	0.693	22.98	432.71
2009	01	06	143B	16	0.866	0.826	0.936	0.826	0.875	0.693	23.20	433.71
2009	01	07	143B	17	0.865	0.825	0.937	0.828	0.878	0.693	23.34	434.71
2009	01	08	143B	18	0.864	0.825	0.936	0.826	0.878	0.693	23.29	435.71
2009	01	09	143B	19	0.865	0.825	0.987	0.862	0.922	0.690	23.18	436.71
2009	01	10	143B	20	0.865	0.824	0.985	0.862	0.920	0.690	23.33	437.71
2009	01	11	143B	21	0.865	0.824	0.985	0.872	0.920	0.690	23.20	438.71
2009	01	12	143B	22	0.864	0.824	0.982	0.872	0.919	0.690	23.12	439.71
2009	01	13	143B	23	0.865	0.823	0.988	0.873	0.918	0.690	23.34	440.71
2009	01	14	143B	24	0.865	0.824	0.988	0.873	0.919	0.690	23.37	441.71
2009	01	15	143B	25	0.864	0.824	0.988	0.873	0.918	0.690	23.36	442.71
2009	01	16	143B	26	0.865	0.824	0.989	0.874	0.919	0.691	23.31	443.71
2009	01	17	143B	27	0.864	0.824	0.989	0.872	0.919	0.700	23.38	444.71
2009	01	18	143B	28	0.864	0.826	0.986	0.872	0.917	0.700	23.41	445.71
2009	01	19	143B	29	0.536	0.575	0.660	0.697	0.691	0.666	22.32	446.21
2009	01	20	143B	30	0.000	0.000	0.000	0.000	0.000	0.000	0.00	446.21
2009	01	21	143B	31	0.915	0.920	0.919	0.926	0.926	0.918	21.99	447.21
2009	01	22	143B	32	0.861	0.823	0.968	0.853	0.905	0.700	23.63	448.21
2009	01	23	143B	33	0.860	0.822	0.985	0.862	0.916	0.700	23.51	449.21
2009	01	24	143B	34	0.861	0.821	0.984	0.862	0.916	0.700	23.29	450.21
2009	01	25	143B	35	0.863	0.824	0.989	0.865	0.920	0.700	23.29	451.21
2009	01	26	143B	36	0.865	0.826	0.990	0.867	0.921	0.700	23.19	452.21
2009	01	27	143B	37	0.864	0.826	0.990	0.868	0.921	0.700	23.15	453.21
2009	01	28	143B	38	0.864	0.826	0.991	0.868	0.922	0.700	23.24	454.21
2009	01	29	143B	39	0.866	0.826	0.992	0.869	0.923	0.700	23.33	455.21
2009	01	30	143B	40	0.866	0.826	0.992	0.869	0.924	0.700	23.43	456.21
2009	01	31	143B	41	0.866	0.826	0.991	0.870	0.923	0.700	23.52	457.21
2009	02	01	143B	42	0.866	0.826	0.991	0.871	0.924	0.700	23.52	458.21
2009	02	02	143B	43	0.867	0.826	0.991	0.871	0.923	0.700	23.38	459.21
2009	02	03	143B	44	0.813	0.827	0.953	0.840	0.896	0.701	23.25	460.21
2009	02	04	143B	45	0.757	0.812	0.913	0.802	0.856	0.702	23.19	461.21
2009	02	05	143B	46	0.725	0.804	0.892	0.789	0.840	0.702	23.15	462.21
2009	02	06	143B	47	0.791	0.818	0.946	0.834	0.885	0.701	22.99	463.21
2009	02	07	143B	48	0.788	0.823	0.957	0.842	0.896	0.700	23.15	464.21
2009	02	08	143B	49	0.752	0.826	0.932	0.824	0.877	0.700	23.26	465.21
2009	02	09	143B	50	0.751	0.826	0.941	0.830	0.883	0.700	23.21	466.21
2009	02	10	143B	51	0.760	0.825	0.962	0.848	0.902	0.700	23.36	467.21
2009	02	11	143B	52	0.759	0.825	0.967	0.857	0.909	0.700	23.30	468.21
2009	02	12	143B	53	0.706	0.827	0.917	0.810	0.864	0.700	23.32	469.21
2009	02	13	143B	54	0.690	0.826	0.910	0.805	0.857	0.700	23.25	470.21
2009	02	14	143B	55	0.694	0.826	0.910	0.802	0.855	0.700	23.24	471.21
2009	02	15	143B	56	0.738	0.825	0.956	0.836	0.891	0.700	23.40	472.21
2009	02	16	143B	57	0.706	0.825	0.948	0.831	0.885	0.700	23.52	473.21
2009	02	17	143B	58	0.703	0.826	0.953	0.839	0.896	0.700	23.60	474.21
2009	02	18	143B	59	0.622	0.760	0.852	0.754	0.802	0.668	23.54	475.21
2009	02	19	143B	60	0.421	0.403	0.485	0.427	0.453	0.497	23.27	476.21
2009	02	20	143B	61	0.533	0.565	0.672	0.697	0.688	0.663	23.14	476.58

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Year	Month	Day	Cycle	Sterbentz Time Step	Capsule 6 (Y Ne)	Capsule 5 (Y Ne)	Capsule 4 (Y Ne)	Capsule 3 (Y Ne)	Capsule 2 (Y Ne)	Capsule 1 (Y Ne)	Eff Power (MW)	Summation of Time at Temperature (Days)
2009	03	12	144A	01	0.000	0.000	0.000	0.000	0.000	0.000	1.62	476.92
2009	03	13	144A	02	0.427	0.445	0.465	0.412	0.439	0.339	20.28	477.92
2009	03	14	144A	03	0.887	0.827	0.995	0.888	0.949	0.600	22.41	478.92
2009	03	15	144A	04	0.878	0.826	0.993	0.885	0.947	0.600	22.44	479.92
2009	03	16	144A	05	0.860	0.827	0.977	0.878	0.940	0.600	22.38	480.92
2009	03	17	144A	06	0.831	0.830	0.944	0.836	0.896	0.600	22.18	481.92
2009	03	18	144A	07	0.879	0.828	0.985	0.873	0.931	0.600	22.37	482.92
2009	03	19	144A	08	0.882	0.828	0.991	0.877	0.936	0.600	22.31	483.92
2009	03	20	144A	09	0.880	0.828	0.991	0.875	0.935	0.600	22.25	484.92
2009	03	21	144A	10	0.839	0.828	0.990	0.874	0.935	0.600	22.31	485.92
2009	03	22	144A	11	0.843	0.827	0.989	0.876	0.934	0.600	22.30	486.92
2009	03	23	144A	12	0.874	0.828	0.988	0.876	0.932	0.600	22.27	487.92
2009	03	24	144A	13	0.881	0.829	0.989	0.875	0.931	0.600	22.28	488.92
2009	03	25	144A	14	0.882	0.828	0.988	0.875	0.930	0.600	22.35	489.92
2009	03	26	144A	15	0.882	0.829	0.988	0.877	0.930	0.600	22.42	490.92
2009	03	27	144A	16	0.881	0.829	0.988	0.876	0.929	0.600	22.44	491.92
2009	03	28	144A	17	0.880	0.827	0.987	0.874	0.928	0.600	22.46	492.92
2009	03	29	144A	18	0.879	0.828	0.987	0.874	0.928	0.600	22.28	493.92
2009	03	30	144A	19	0.880	0.828	0.988	0.874	0.929	0.600	22.36	494.92
2009	03	31	144A	20	0.865	0.828	0.987	0.874	0.930	0.600	22.21	495.92
2009	04	01	144A	21	0.845	0.828	0.987	0.877	0.932	0.600	22.25	496.92
2009	04	02	144A	22	0.853	0.827	0.986	0.876	0.930	0.600	22.39	497.92
2009	04	03	144A	23	0.860	0.827	0.986	0.876	0.929	0.600	22.39	498.92
2009	04	04	144A	24	0.878	0.828	0.987	0.874	0.928	0.600	22.29	499.92
2009	04	05	144A	25	0.879	0.828	0.988	0.875	0.928	0.600	22.34	500.92
2009	04	06	144A	26	0.879	0.828	0.987	0.875	0.927	0.600	22.34	501.92
2009	04	07	144A	27	0.878	0.827	0.987	0.874	0.926	0.600	22.42	502.92
2009	04	08	144A	28	0.855	0.827	0.987	0.874	0.927	0.600	22.35	503.92
2009	04	09	144A	29	0.808	0.826	0.986	0.875	0.929	0.600	22.36	504.92
2009	04	10	144A	30	0.785	0.826	0.986	0.875	0.929	0.600	22.36	505.92
2009	04	11	144A	31	0.804	0.826	0.986	0.875	0.929	0.600	22.48	506.92
2009	04	12	144A	32	0.755	0.827	0.987	0.875	0.930	0.600	22.50	507.92
2009	04	13	144A	33	0.728	0.822	0.986	0.870	0.925	0.600	22.60	508.92
2009	04	14	144A	34	0.783	0.834	0.989	0.881	0.931	0.600	22.34	509.92
2009	04	15	144A	35	0.785	0.826	0.985	0.876	0.929	0.600	22.29	510.92
2009	04	16	144A	36	0.741	0.827	0.986	0.877	0.930	0.600	22.26	511.92
2009	04	17	144A	37	0.693	0.826	0.987	0.876	0.931	0.600	22.43	512.92
2009	04	18	144A	38	0.709	0.827	0.987	0.876	0.931	0.600	22.36	513.92
2009	04	19	144A	39	0.741	0.827	0.987	0.876	0.931	0.600	22.54	514.92
2009	04	20	144A	40	0.709	0.827	0.987	0.875	0.931	0.600	22.73	515.92
2009	04	21	144A	41	0.660	0.825	0.987	0.872	0.937	0.600	22.64	516.92
2009	04	22	144A	42	0.602	0.824	0.971	0.871	0.938	0.600	22.55	517.92
2009	04	23	144A	43	0.538	0.800	0.916	0.823	0.891	0.600	22.43	518.92
2009	04	24	144A	44	0.480	0.765	0.859	0.758	0.820	0.600	22.45	519.92
2009	04	25	144A	45	0.334	0.557	0.611	0.540	0.581	0.471	21.19	520.67

Y = Mole Fraction

Grant purposefully zeroed this value out

Redone to average only while reactor is at power

Year	Month	Day	Cycle	Sterbentz Time Step	Capsule 6 (Y Ne)	Capsule 5 (Y Ne)	Capsule 4 (Y Ne)	Capsule 3 (Y Ne)	Capsule 2 (Y Ne)	Capsule 1 (Y Ne)	Eff Power (MW)	Summation of Time at Temperature (Days)
2009	05	10	144B	01	0.025	0.041	0.049	0.044	0.047	0.053	8.06	521.00
2009	05	11	144B	02	0.863	0.794	0.961	0.865	0.915	0.599	21.84	522.00
2009	05	12	144B	03	0.853	0.821	0.995	0.892	0.946	0.600	21.69	523.00
2009	05	13	144B	04	0.866	0.822	0.994	0.892	0.946	0.600	21.82	524.00
2009	05	14	144B	05	0.866	0.821	0.993	0.891	0.945	0.600	21.88	525.00
2009	05	15	144B	06	0.866	0.821	0.993	0.890	0.944	0.600	21.62	526.00
2009	05	16	144B	07	0.841	0.821	0.993	0.888	0.942	0.600	21.61	527.00
2009	05	17	144B	08	0.801	0.821	0.994	0.884	0.939	0.600	21.68	528.00
2009	05	18	144B	09	0.773	0.821	0.992	0.881	0.936	0.600	21.61	529.00
2009	05	19	144B	10	0.851	0.822	0.991	0.879	0.932	0.600	21.52	530.00
2009	05	20	144B	11	0.765	0.825	0.992	0.880	0.933	0.600	21.69	531.00
2009	05	21	144B	12	0.883	0.825	0.990	0.881	0.931	0.600	21.79	532.00
2009	05	22	144B	13	0.882	0.825	0.989	0.880	0.929	0.600	21.89	533.00
2009	05	23	144B	14	0.880	0.824	0.988	0.878	0.927	0.600	21.67	534.00
2009	05	24	144B	15	0.879	0.823	0.986	0.876	0.925	0.600	21.70	535.00
2009	05	25	144B	16	0.878	0.823	0.986	0.876	0.925	0.600	21.53	536.00
2009	05	26	144B	17	0.876	0.824	0.987	0.876	0.926	0.600	21.30	537.00
2009	05	27	144B	18	0.861	0.823	0.988	0.875	0.925	0.600	21.50	538.00
2009	05	28	144B	19	0.636	0.650	0.770	0.636	0.649	0.408	21.44	539.00
2009	05	29	144B	20	0.601	0.799	0.758	0.765	0.751	0.388	21.39	540.00
2009	05	30	144B	21	0.675	1.000	1.000	1.000	1.000	0.600	21.34	541.00
2009	05	31	144B	22	0.616	0.954	0.936	0.943	0.941	0.559	21.48	541.79
2009	06	02	144B	23	0.084	0.172	0.000	0.114	0.073	0.001	0.00	541.79
2009	06	03	144B	24	0.336	0.403	0.292	0.378	0.344	0.194	17.83	542.58
2009	06	04	144B	25	0.652	0.908	0.892	0.907	0.901	0.553	21.51	543.58
2009	06	05	144B	26	0.558	0.952	0.997	1.000	1.000	0.600	21.38	544.58
2009	06	06	144B	27	0.591	0.989	1.000	1.000	1.000	0.600	21.36	545.58
2009	06	07	144B	28	0.581	0.990	1.000	1.000	1.000	0.600	21.18	546.58
2009	06	08	144B	29	0.547	0.960	0.995	0.996	0.996	0.600	21.18	547.58
2009	06	09	144B	30	0.492	0.914	0.961	0.964	0.961	0.600	21.10	548.58
2009	06	10	144B	31	0.464	0.895	0.946	0.952	0.950	0.600	21.25	549.58
2009	06	11	144B	32	0.559	0.980	1.000	0.972	0.970	0.600	21.23	550.58
2009	06	12	144B	33	0.521	0.967	1.000	0.800	0.785	0.600	21.10	551.58
2009	06	13	144B	34	0.515	0.960	1.000	0.800	0.785	0.600	21.22	552.58
2009	06	14	144B	35	0.501	0.958	1.000	0.800	0.785	0.600	21.33	553.58
2009	06	15	144B	36	0.489	0.950	0.989	0.800	0.785	0.600	21.31	554.58
2009	06	16	144B	37	0.562	1.000	1.000	0.800	0.786	0.600	21.39	555.58
2009	06	17	144B	38	0.524	1.000	1.000	0.800	0.786	0.600	21.48	556.58
2009	06	18	144B	39	0.588	1.000	1.000	0.800	0.786	0.600	21.38	557.58
2009	06	19	144B	40	0.548	1.000	1.000	0.800	0.786	0.600	21.47	558.58
2009	06	20	144B	41	0.508	0.995	1.000	0.800	0.785	0.600	21.32	559.58
2009	06	21	144B	42	0.488	0.986	1.000	0.799	0.785	0.600	21.41	560.58
2009	06	22	144B	43	0.428	0.935	0.992	0.799	0.784	0.600	21.49	561.58
2009	06	23	144B	44	0.384	0.893	0.963	0.799	0.784	0.600	21.49	562.58
2009	06	24	144B	45	0.404	0.919	0.977	0.799	0.784	0.600	21.27	563.58
2009	06	25	144B	46	0.409	0.931	0.984	0.799	0.785	0.600	21.17	564.58
2009	06	26	144B	47	0.349	0.877	0.956	0.800	0.785	0.600	21.24	565.58
2009	06	27	144B	48	0.331	0.862	0.944	0.799	0.785	0.600	21.16	566.58
2009	06	28	144B	49	0.349	0.890	0.964	0.799	0.785	0.600	21.22	567.58
2009	06	29	144B	50	0.434	0.947	0.986	0.798	0.786	0.600	21.65	568.58
2009	06	30	144B	51	0.476	1.000	1.000	0.800	0.786	0.600	21.64	569.58
2009	07	01	144B	52	0.410	0.966	1.000	0.800	0.786	0.600	21.63	570.58
2009	07	02	144B	53	0.331	0.894	0.964	0.800	0.786	0.600	21.77	571.58
2009	07	03	144B	54	0.305	0.806	0.865	0.708	0.688	0.516	21.75	572.71

Y = Mole Fraction

Grant purposefully zeroed this value out

Redone to average only while reactor is at power

Year	Month	Day	Cycle	Sterbentz Time Step	Capsule 6 (Y Ne)	Capsule 5 (Y Ne)	Capsule 4 (Y Ne)	Capsule 3 (Y Ne)	Capsule 2 (Y Ne)	Capsule 1 (Y Ne)	Eff Power (MW)	Summation of Time at Temperature (Days)
2009	09	05	145A	01	0.070	0.205	0.018	0.150	0.090	0.025	10.59	573.17
2009	09	05	145A	02	0.310	0.418	0.288	0.156	0.096	0.012	20.80	573.63
2009	09	06	145A	03	1.000	1.000	1.000	0.553	0.531	0.373	20.88	574.63
2009	09	07	145A	04	1.000	1.000	1.000	0.808	0.802	0.607	20.82	575.63
2009	09	08	145A	05	0.857	1.000	0.999	0.810	0.805	0.610	21.49	576.63
2009	09	09	145A	06	0.764	1.000	1.000	0.892	0.894	0.692	22.35	577.63
2009	09	10	145A	07	0.966	1.000	1.000	0.992	1.000	0.791	22.39	578.63
2009	09	11	145A	08	0.962	1.000	1.000	0.992	1.000	0.813	22.28	579.63
2009	09	12	145A	09	0.918	1.000	1.000	0.992	1.000	0.802	22.22	580.63
2009	09	13	145A	10	0.869	1.000	1.000	0.992	1.000	0.804	22.12	581.63
2009	09	14	145A	11	0.978	1.000	1.000	0.992	1.000	0.812	22.08	582.63
2009	09	15	145A	12	0.885	1.000	1.000	0.994	1.000	0.806	22.17	583.63
2009	09	16	145A	13	0.958	1.000	1.000	0.997	1.000	0.797	22.31	584.63
2009	09	17	145A	14	0.937	1.000	1.000	0.996	1.000	0.794	22.56	585.63
2009	09	18	145A	15	0.951	1.000	1.000	0.997	1.000	0.795	22.68	586.63
2009	09	19	145A	16	0.960	1.000	1.000	0.997	1.000	0.805	22.49	587.63
2009	09	20	145A	17	0.960	1.000	1.000	0.997	1.000	0.805	22.71	588.63
2009	09	21	145A	18	0.965	1.000	1.000	0.996	1.000	0.814	22.68	589.63
2009	09	22	145A	19	0.963	1.000	1.000	0.997	1.000	0.811	22.64	590.63
2009	09	23	145A	20	0.929	1.000	1.000	0.997	1.000	0.811	22.60	591.63
2009	09	24	145A	21	0.930	1.000	1.000	0.997	1.000	0.806	22.59	592.63
2009	09	25	145A	22	0.965	1.000	1.000	0.997	1.000	0.796	22.58	593.63
2009	09	26	145A	23	0.974	1.000	1.000	0.997	1.000	0.800	22.60	594.63
2009	09	27	145A	24	0.974	1.000	1.000	0.997	1.000	0.800	22.56	595.63
2009	09	28	145A	25	0.988	1.000	1.000	0.997	1.000	0.800	22.50	596.63
2009	09	29	145A	26	0.884	0.918	0.877	0.903	0.895	0.723	22.48	596.96
2009	09	30	145A	27	0.043	0.201	0.023	0.140	0.089	0.020	0.00	596.96
2009	10	01	145A	28	0.236	0.347	0.217	0.314	0.268	0.164	14.86	597.46
2009	10	01	145A	29	0.987	0.989	1.000	0.996	0.988	0.788	22.97	597.88
2009	10	02	145A	30	0.994	1.000	1.000	0.996	1.000	0.790	22.68	598.88
2009	10	03	145A	31	0.972	1.000	1.000	0.996	1.000	0.793	22.57	599.88
2009	10	04	145A	32	0.961	1.000	1.000	0.997	1.000	0.793	22.59	600.88
2009	10	05	145A	33	0.911	1.000	1.000	0.996	1.000	0.793	22.54	601.88
2009	10	06	145A	34	0.917	1.000	1.000	0.996	1.000	0.793	22.53	602.88
2009	10	07	145A	35	0.883	1.000	1.000	0.996	1.000	0.807	22.44	603.92
2009	10	09	145A	36	0.041	0.201	0.022	0.138	0.084	0.025	0.00	603.92
2009	10	10	145A	37	0.060	0.197	0.029	0.151	0.091	0.009	15.07	604.38
2009	10	11	145A	38	0.803	0.850	0.826	0.844	0.837	0.652	22.75	605.38
2009	10	12	145A	39	0.835	0.950	0.927	0.939	0.937	0.744	22.65	606.13
2009	10	14	145A	40	0.044	0.201	0.024	0.140	0.086	0.026	0.00	606.13
2009	10	15	145A	41	0.055	0.198	0.028	0.148	0.089	0.016	8.08	606.46
2009	10	15	145A	42	0.763	0.809	0.770	0.774	0.752	0.588	23.13	606.96
2009	10	16	145A	43	0.905	1.000	1.000	0.997	1.000	0.797	22.80	607.96
2009	10	17	145A	44	0.793	1.000	1.000	0.997	1.000	0.799	22.73	608.96
2009	10	18	145A	45	0.754	1.000	1.000	0.997	1.000	0.807	22.52	609.96
2009	10	19	145A	46	0.731	1.000	1.000	0.997	1.000	0.810	22.45	610.96
2009	10	20	145A	47	0.741	1.000	1.000	0.997	1.000	0.808	22.51	611.96
2009	10	21	145A	48	0.802	1.000	1.000	0.996	1.000	0.807	22.54	612.96
2009	10	22	145A	49	0.758	1.000	1.000	0.996	1.000	0.802	22.62	613.96
2009	10	23	145A	50	0.716	1.000	1.000	0.996	1.000	0.802	22.65	614.96
2009	10	24	145A	51	0.793	1.000	1.000	0.996	1.000	0.802	22.64	615.96
2009	10	25	145A	52	0.736	1.000	1.000	0.996	1.000	0.802	22.60	616.96
2009	10	26	145A	53	0.709	1.000	1.000	0.996	1.000	0.802	22.57	617.96
2009	10	27	145A	54	0.726	1.000	1.000	0.996	1.000	0.802	22.72	618.96
2009	10	28	145A	55	0.735	1.000	1.000	0.996	1.000	0.795	22.75	619.96
2009	10	29	145A	56	0.660	1.000	1.000	0.996	1.000	0.809	22.68	620.96
2009	10	30	145A	57	0.684	1.000	1.000	0.996	1.000	0.810	22.76	621.96
2009	10	31	145A	58	0.638	1.000	1.000	0.996	1.000	0.810	22.73	622.96
2009	11	01	145A	59	0.592	1.000	1.000	0.996	1.000	0.317	22.50	623.96
2009	11	02	145A	60	0.592	1.000	0.976	0.995	1.000	0.013	22.73	624.96
2009	11	03	145A	61	0.542	1.000	0.999	0.996	1.000	0.000	22.66	625.96
2009	11	04	145A	62	0.489	1.000	1.000	0.996	1.000	0.000	22.72	626.96
2009	11	05	145A	63	0.414	1.000	1.000	0.996	1.000	0.000	22.68	628.17

APPENDIX D—Computer Files on Icestorm

```
service0.995 ~/agr/dailycalcs => cd run_2b/
service0.996 ~/agr/dailycalcs/run_2b => ll
total 72
drwxr-xr-x 18 haw 4096 2011-07-25 16:25 ./
drwxr-xr-x 27 haw 4096 2011-06-15 16:29 ../
drwxr-xr-x  4 haw 4096 2011-10-03 10:03 138B/
drwxr-xr-x  2 haw 4096 2011-05-17 09:45 139A/
drwxr-xr-x  2 haw 4096 2011-05-17 09:45 139B/
drwxr-xr-x  2 haw 4096 2011-05-17 09:45 140A/
drwxr-xr-x  2 haw 4096 2011-05-17 09:45 140B/
drwxr-xr-x  4 haw 4096 2011-09-30 14:00 141A/
drwxr-xr-x  2 haw 4096 2011-05-17 09:45 142A/
drwxr-xr-x  2 haw 4096 2011-07-12 10:51 142B/
drwxr-xr-x  2 haw 4096 2011-05-17 09:45 143A/
drwxr-xr-x  2 haw 4096 2011-05-17 09:45 143B/
drwxr-xr-x  2 haw 4096 2011-05-17 09:45 144A/
drwxr-xr-x  2 haw 4096 2011-05-17 09:45 144B/
drwxr-xr-x  2 haw 4096 2011-08-24 14:40 145A/
drwxr-xr-x  3 haw 4096 2011-07-25 16:18 master/
drwxr-xr-x  2 haw 4096 2011-08-24 14:39 models/
service0.997 ~/agr/dailycalcs/2nd_run => cd 141A
service0.998 ~/agr/dailycalcs/2nd_run/141A => ll
total 12392108
drwxr-xr-x  4 haw       4096 2011-09-30 14:00 ./
drwxr-xr-x 18 haw       4096 2011-07-25 16:25 ../
-rwxr--r--  1 haw      15773 2011-05-15 00:01 141A_cap1.com*
-rw-r--r--  1 haw  129713885 2011-05-15 01:21 141A_cap1.dat
-rw-r--r--  1 haw  226126296 2011-05-15 01:21 141A_cap1.fil
-rw-r--r--  1 haw         10 2011-05-10 11:05 141A_cap1.if
-rw-r--r--  1 haw   33090981 2011-05-13 15:15 141A_cap1.inp
-rw-r--r--  1 haw     257305 2011-05-15 01:21 141A_cap1.msg
-rw-r--r--  1 haw 1655122532 2011-05-15 01:21 141A_cap1.odb
-rw-r--r--  1 haw        144 2011-05-15 01:21 141A_cap1.of
-rw-r--r--  1 haw      14995 2011-05-15 01:21 141A_cap1.out
-rw-r--r--  1 haw      14884 2011-05-15 01:21 141A_cap1.outc
-rw-r--r--  1 haw       1383 2011-05-13 14:53 141A_cap1.sh
-rw-r--r--  1 haw       2655 2011-05-15 01:21 141A_cap1.sta
-rw-r--r--  1 haw     148036 2011-05-13 14:52 141A_cap1.steps
-rwxr--r--  1 haw      15772 2011-05-15 01:00 141A_cap2.com*
-rw-r--r--  1 haw  133841724 2011-05-15 02:35 141A_cap2.dat
-rw-r--r--  1 haw  228925224 2011-05-15 02:35 141A_cap2.fil
-rw-r--r--  1 haw         10 2011-05-10 11:05 141A_cap2.if
-rw-r--r--  1 haw   35149136 2011-05-13 15:15 141A_cap2.inp
-rw-r--r--  1 haw     259032 2011-05-15 02:35 141A_cap2.msg
-rw-r--r--  1 haw 1738142596 2011-05-15 02:35 141A_cap2.odb
-rw-r--r--  1 haw        144 2011-05-15 02:35 141A_cap2.of
-rw-r--r--  1 haw      14995 2011-05-15 02:35 141A_cap2.out
-rw-r--r--  1 haw      14884 2011-05-15 02:35 141A_cap2.outc
-rw-r--r--  1 haw       1383 2011-05-13 14:53 141A_cap2.sh
-rw-r--r--  1 haw       2655 2011-05-15 02:35 141A_cap2.sta
-rw-r--r--  1 haw     148057 2011-05-13 14:52 141A_cap2.steps
-rwxr--r--  1 haw      15773 2011-05-15 02:00 141A_cap3.com*
-rw-r--r--  1 haw  133682491 2011-05-15 03:30 141A_cap3.dat
-rw-r--r--  1 haw  228748752 2011-05-15 03:30 141A_cap3.fil
-rw-r--r--  1 haw         10 2011-05-10 11:05 141A_cap3.if
-rw-r--r--  1 haw   34947622 2011-05-13 15:15 141A_cap3.inp
-rw-r--r--  1 haw     258389 2011-05-15 03:30 141A_cap3.msg
-rw-r--r--  1 haw 1737956692 2011-05-15 03:30 141A_cap3.odb
-rw-r--r--  1 haw        144 2011-05-15 03:30 141A_cap3.of
-rw-r--r--  1 haw      14995 2011-05-15 03:30 141A_cap3.out
-rw-r--r--  1 haw      14884 2011-05-15 03:30 141A_cap3.outc
-rw-r--r--  1 haw       1383 2011-05-13 14:53 141A_cap3.sh
-rw-r--r--  1 haw       2655 2011-05-15 03:30 141A_cap3.sta
-rw-r--r--  1 haw     148057 2011-05-13 14:52 141A_cap3.steps
-rwxr--r--  1 haw      15772 2011-05-15 03:00 141A_cap4.com*
-rw-r--r--  1 haw  133677221 2011-05-15 04:32 141A_cap4.dat
-rw-r--r--  1 haw  228744648 2011-05-15 04:32 141A_cap4.fil
-rw-r--r--  1 haw         10 2011-05-10 11:05 141A_cap4.if
-rw-r--r--  1 haw   34950412 2011-05-13 15:15 141A_cap4.inp
-rw-r--r--  1 haw     258074 2011-05-15 04:32 141A_cap4.msg
-rw-r--r--  1 haw 1737954296 2011-05-15 04:32 141A_cap4.odb
-rw-r--r--  1 haw        144 2011-05-15 04:32 141A_cap4.of
-rw-r--r--  1 haw      14995 2011-05-15 04:32 141A_cap4.out
-rw-r--r--  1 haw      14884 2011-05-15 04:32 141A_cap4.outc
-rw-r--r--  1 haw       1383 2011-05-13 14:53 141A_cap4.sh
-rw-r--r--  1 haw       2655 2011-05-15 04:32 141A_cap4.sta
-rw-r--r--  1 haw     148056 2011-05-13 14:52 141A_cap4.steps
-rwxr--r--  1 haw      15773 2011-05-15 04:00 141A_cap5.com*
-rw-r--r--  1 haw  133834426 2011-05-15 05:32 141A_cap5.dat
-rw-r--r--  1 haw  228925224 2011-05-15 05:32 141A_cap5.fil
-rw-r--r--  1 haw         10 2011-05-10 11:05 141A_cap5.if
-rw-r--r--  1 haw   35126167 2011-05-13 15:15 141A_cap5.inp
-rw-r--r--  1 haw     256347 2011-05-15 05:32 141A_cap5.msg
-rw-r--r--  1 haw 1738142596 2011-05-15 05:32 141A_cap5.odb
-rw-r--r--  1 haw        144 2011-05-15 05:32 141A_cap5.of
-rw-r--r--  1 haw      14995 2011-05-15 05:32 141A_cap5.out
-rw-r--r--  1 haw      14884 2011-05-15 05:32 141A_cap5.outc
-rw-r--r--  1 haw       1383 2011-05-13 14:54 141A_cap5.sh
-rw-r--r--  1 haw       2655 2011-05-15 05:32 141A_cap5.sta
-rw-r--r--  1 haw     148057 2011-05-13 14:52 141A_cap5.steps
-rwxr--r--  1 haw      15772 2011-05-15 05:00 141A_cap6.com*
-rw-r--r--  1 haw  129691396 2011-05-15 06:25 141A_cap6.dat
-rw-r--r--  1 haw  226097568 2011-05-15 06:25 141A_cap6.fil
-rw-r--r--  1 haw         10 2011-05-10 11:05 141A_cap6.if
-rw-r--r--  1 haw   33065004 2011-05-13 15:15 141A_cap6.inp
-rw-r--r--  1 haw     258468 2011-05-15 06:25 141A_cap6.msg
-rw-r--r--  1 haw 1655117364 2011-05-15 06:25 141A_cap6.odb
-rw-r--r--  1 haw        144 2011-05-15 06:25 141A_cap6.of
-rw-r--r--  1 haw      14995 2011-05-15 06:25 141A_cap6.out
-rw-r--r--  1 haw      14884 2011-05-15 06:25 141A_cap6.outc
-rw-r--r--  1 haw       1383 2011-05-13 14:54 141A_cap6.sh
-rw-r--r--  1 haw       2655 2011-05-15 06:25 141A_cap6.sta
-rw-r--r--  1 haw     148098 2011-05-13 14:52 141A_cap6.steps
-rwxr-xr-x  1 haw      80138 2011-05-10 11:05
agrcomp_reader.exe*
-rwxr-xr-x  1 haw     892555 2011-07-26 08:21 step_writer.x*
```

Computer Files on Icestorm on AGR1

```
/home/haw> cd agr1
service0.985 ~/agr1 => ll
total 24
drwxrws---+  3 agr1    20 2011-04-26 17:36 ./
drwxr-xr-x   6 root     0 2011-10-10 11:05 ../
drwxrws---+ 16 agr1 16384 2011-05-13 13:30 2nd_run/
service0.986 ~/agr1 => cd 2nd_run/
service0.987 ~/agr1/2nd_run => ll
total 288
drwxrws---+ 16 agr1 16384 2011-05-13 13:30 ./
drwxrws---+  3 agr1    20 2011-04-26 17:36 ../
drwxrws---+  3 agr1 16384 2011-09-30 14:00 138B/
drwxrws---+  3 agr1 16384 2011-06-14 14:13 139A/
drwxrws---+  3 agr1 16384 2011-07-11 11:51 139B/
drwxrws---+  3 agr1 16384 2011-06-14 14:11 140A/
drwxrws---+  3 agr1 16384 2011-06-14 14:10 140B/
drwxrws---+  3 agr1 16384 2011-07-07 16:59 141A/
drwxrws---+  3 agr1 16384 2011-06-14 14:05 142A/
drwxrws---+  3 agr1 16384 2011-06-14 14:04 142B/
drwxrws---+  3 agr1 16384 2011-06-14 14:03 143A/
drwxrws---+  3 agr1 16384 2011-06-14 14:02 143B/
drwxrws---+  3 agr1 16384 2011-06-14 14:01 144A/
drwxrws---+  3 agr1 16384 2011-06-14 10:49 144B/
drwxrws---+  3 agr1 16384 2011-06-14 10:47 145A/
drwxrws---+  2 agr1    27 2011-05-10 11:29 master/
service0.988 ~/agr1/2nd_run => cd 141A/
service0.989 ~/agr1/2nd_run/141A => ll
total 99624
drwxrws---+  3 agr1   16384 2011-07-07 16:59 ./
drwxrws---+ 16 agr1   16384 2011-05-13 13:30 ../
-rw-rwx---+  1 agr1    3501 2011-05-10 11:05
141A_Gas_Fluence_Capsule_Data*
-rw-rwx---+  1 agr1 3537809 2011-06-14 14:06
act1a.mcnp.inp.141AA.ts.34.output*
-rw-rwx---+  1 agr1 3537809 2011-06-14 14:06
act1a.mcnp.inp.141AA.ts.35.output*
-rw-rwx---+  1 agr1 4987323 2011-04-28 17:17 b8comp2.check.1*
-rw-rwx---+  1 agr1 2694097 2011-04-28 17:17 b8comp2.check.10*
-rw-rwx---+  1 agr1 2694097 2011-04-28 17:17 b8comp2.check.11*
-rw-rwx---+  1 agr1 2694097 2011-04-28 17:17 b8comp2.check.12*
-rw-rwx---+  1 agr1 2694097 2011-04-28 17:17 b8comp2.check.13*
-rw-rwx---+  1 agr1 2694097 2011-04-28 17:17 b8comp2.check.14*
-rw-rwx---+  1 agr1 2694097 2011-04-28 17:17 b8comp2.check.15*
-rw-rwx---+  1 agr1 2694097 2011-04-28 17:17 b8comp2.check.16*
-rw-rwx---+  1 agr1 2694097 2011-04-28 17:17 b8comp2.check.17*
-rw-rwx---+  1 agr1 2694097 2011-04-28 17:17 b8comp2.check.18*
-rw-rwx---+  1 agr1 2694097 2011-04-28 17:17 b8comp2.check.19*
-rw-rwx---+  1 agr1 2694097 2011-04-28 17:17 b8comp2.check.2*
-rw-rwx---+  1 agr1 2694097 2011-04-28 17:17 b8comp2.check.20*
-rw-rwx---+  1 agr1 2694097 2011-04-28 17:17 b8comp2.check.21*
-rw-rwx---+  1 agr1 2694097 2011-04-28 17:17 b8comp2.check.22*
-rw-rwx---+  1 agr1 2694097 2011-04-28 17:17 b8comp2.check.23*
-rw-rwx---+  1 agr1 2694097 2011-04-28 17:17 b8comp2.check.24*
-rw-rwx---+  1 agr1 2694097 2011-04-28 17:17 b8comp2.check.25*
-rw-rwx---+  1 agr1 2694097 2011-04-28 17:17 b8comp2.check.26*
-rw-rwx---+  1 agr1 2694097 2011-04-28 17:17 b8comp2.check.27*
-rw-rwx---+  1 agr1 2694097 2011-04-28 17:17 b8comp2.check.28*
-rw-rwx---+  1 agr1 2694097 2011-04-28 17:17 b8comp2.check.29*
-rw-rwx---+  1 agr1 2694097 2011-04-28 17:17 b8comp2.check.3*
-rw-rwx---+  1 agr1 2694097 2011-04-28 17:17 b8comp2.check.30*
-rw-rwx---+  1 agr1 2694097 2011-04-28 17:17 b8comp2.check.31*
-rw-rwx---+  1 agr1 2694097 2011-04-28 17:17 b8comp2.check.32*
-rw-rwx---+  1 agr1 2694097 2011-04-28 17:17 b8comp2.check.33*
-rw-rwx---+  1 agr1 2666881 2011-04-28 17:17 b8comp2.check.34*
-rw-rwx---+  1 agr1 2694097 2011-04-28 17:17 b8comp2.check.4*
-rw-rwx---+  1 agr1 2694097 2011-04-28 17:17 b8comp2.check.5*
-rw-rwx---+  1 agr1 2694097 2011-04-28 17:17 b8comp2.check.6*
-rw-rwx---+  1 agr1 2694097 2011-04-28 17:17 b8comp2.check.7*
-rw-rwx---+  1 agr1 2694097 2011-04-28 17:17 b8comp2.check.8*
-rw-rwx---+  1 agr1 2694097 2011-04-28 17:17 b8comp2.check.9*
-rw-rwx---+  1 agr1   99985 2011-04-30 17:50
combobor.hawkes.141A.output*
-rw-rwx---+  1 agr1  581328 2011-04-30 16:17
combo.hawkes.141A.output*
-rwxrwx---+  1 agr1    1847 2011-05-10 11:21 grepper_141A*
drwxrws---+  2 agr1   16384 2011-07-07 17:00 heat/
-rw-rwx---+  1 agr1  108583 2011-04-28 16:48
heatr4.17.components.141A.output*
```